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Master's Thesis
Academic Year 2018

The Maze Game: The Application of Non-Verbal Communication in Enhancing Game Experience for Cooperative Online Game

Graduate School of Media Design,
Keio University

Yuluan Zhu

A Master's Thesis
submitted to Graduate School of Media Design, Keio University
in partial fulfillment of the requirements for the degree of
MASTER of Media Design

Yuluan Zhu

Thesis Committee:

Professor Kazunori Sugiura	(Supervisor)
Professor Matthew Waldman	(Co-Supervisor)
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Abstract of Master's Thesis of Academic Year 2018

The Maze Game: The Application of Non-Verbal Communication in Enhancing Game Experience for Cooperative Online Game

Category: Design

Summary

Non-Verbal communication is widely used in daily life as an alternative communication method. People use non-verbal communication to assist their expression or as an independent communication method. However, this method of communication has not yet been widely used in Virtual Environment, which could be a good alternative method to solve current communication difficulties in virtual environment.

This thesis aims to address the design of a non-verbal communication based cooperative online game. The game uses non-verbal communication as its main communication method with the assist of textual message. Two players play this game should collaboratively work together to solve the puzzle and reach the goal. In order to achieve the design, the two players are designed to have different information and tasks so as to force the cooperative game play. It is hypothesized that with non-verbal communication designed for the players, players can have enhanced game experience in joyfulness and willingness in using NVC, and afford more accurate communication in the game.

The result of evaluation for the design has collected significant supportive data that can indicate the accuracy of non-verbal communication, as well as the joyfulness and enhanced game experience.

Keywords:

Networked cooporative game, Non-Verbal Communication, Game Design

Graduate School of Media Design, Keio University

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1. Background

As time has stepped into year 2018, the era of digital age, there seems to be not many elements that are not concerned about computer or the Internet. If anyone looks back to the years before year 2000, one would be astonished how hugely the way of life has changed during the 20 years. At this point of time, people can easily use any of mobile app to guide their trip, look up information on the Internet, play network video games or even have virtual reality face-to-face video call. Indeed that advancing technology has massively improved a vast areas of life, and the reason of which is because the very minor part of the area has been improved massively as well during these years. If we look into the video game area, almost every part of video game has been greatly improved. One of the most obvious improvement should be graphical. Credit to Moores Law, which claims that the number of transistors in a dense integrated circuit doubles about every two years [13], computer graphic technology has been significantly upgraded, allowing more realistic and more various game content and graphic.

In the recent 5 years, most of networked video games provided players with fancy game graphical display, smooth control and stable network connection. This has supported a number of game functions like players can see through the avatar's eyes and control the avatars body, as if the players are controlling his/her own body. More additionally, in a networked online gaming session, players are able to see other player's avatar and make interaction with it. However, with all the

positive aspect listed above, there are still several negative aspects of video games that have room to be improved. Imagine in a first-person perspective game, where one player has tactical information to share with the other players in the same virtual space, this player wants to talk with others but finds himself/herself not possessing any communication hardware or they don't speak the same language. So, this disadvantage could result in communication difficulty for online game players. Usually, in many cases, when a player finds himself/herself not being able to talk through microphone or other voice transmission devices, the player would choose to either using text messages in games or using nonverbal communication.

1.2. Communication difficulty in online gaming

While using text messages in online games, player may find some difficulties or issues in such method. In some fast-paced video games, especially first-person shooter games, text takes rather long time to type the words that describes what the player tries to convey. Usually, in first-person perspective games, keyboard and mouse are used as the default input device on PC platform. Player needs to press W, S, A and D (each corresponding to go forward, backward, left and right) for controlling avatar movement. But in the same time, keyboard also acts as the only text input deviceplayer needs to press a key (usually Y or Enter) to invoke the texting panel. Once the panel is invoked, it cannot be undone until player choose to send the message out by pressing the sending button. Most of the players choose to type with both hands on the keyboard, with mouse left uncontrolled, which could be fatal in competitive online games, not only because the mouse is uncontrolled but also whichever key user presses to control the avatar, it would become texts in text message panel instead of control command to the avatar. Sometimes text messages could result in devastate consequence to players game experience, such as being slowed down when theres time limit or being neutralized by enemy while typing.

In addition to fast-paced first-person shooter games, text can also be blurring or inaccurate in some situation. In reality, if someone says on the right of the building through telephone, then the "on the right" could have countless possibilities based on different perspective and location of the viewer. In some games,

Figure 1.1: Football referee using non-verbal gesture to explain the situation

one player needs to inform the other where or which certain direction that he/she needs to go, and text could be really inaccurate because it usually doesnt give people with the corresponding spatial recognition. Also due to different perspective, same words could mean different direction or position. In the game Playerunknown's Battleground, player often finds himself/herself under attack from other hostile players. However, the player is very likely not aware where the attack comes from because the game has a huge-sized map and varies of terrains. Being aware of which direction that attacks come from is one of the most vital element, but through the in-game voice chat player sometimes cannot communicate with enough accurate information.

Meanwhile, the other way of communication, nonverbal communication, does provide players with alternative communication method apart from verbal communication.

1.3. Non-Verbal Communication

Non-Verbal Communication, shorted as NVC, is another way of communication without using any forms of verbal communication such as textual message, vocal message or symbols. Instead of them, nonverbal communication tends to use more natural, body-wised communication to communicate with people. The

action can involve any body movement, tilting of a head, waving your hand, and even to kicking your feet, which are gifted as soon as ones born. It usually is used when there is language barrier or disability of talking, or sometimes when somebody wants to demonstrate spatial guidance. In reality, it is quite simple to do the action: just move your own body and do the gesture, the only uncertainty is only whether the receiver can understand the message that is conveyed. Online video game is a different and more difficult situation, however. In most games, player is only able to control the avatars direction that its facing and move the avatar forward. Being able to use non-verbal communication such as gestures in online games could be a great enhance to the game experience.

1.4. Hypothesis and Expectations

The objective of this project is to design a non-verbal communication based game to enhance player's game experience in communication and game play. It is expected that the design of the game can increase the accuracy of communication in game by using non-verbal communication as an independent communication method. Meanwhile, the game is expected to provide its players with joyfulness and the unique joy of game play by using non-verbal communication.Moreover, by using non-verbal communication, the game is expected to provide more efficient communication process and more direction illustration in communication. To achieve the above expectations, the game should have well designed game structure with adequate difficulty and challenge, well functioned non-verbal communication functions and good evaluation method.

1.5. Thesis Structure

Chapter 1 is the chapter introduces the background information about the project. And it briefly introduced the objective and goal of the project.

Chapter 2 is the chapter has the information of related works to this project, as well as the supportive papers or literatures that can support the hypothesis and methodology of this thesis.

Chapter 3 is the chapter has the detailed information about the design of the project. It explains the reason, the process and the actual detail of the design.

Chapter 4 is the chapter illustrate the process of implementation and evaluation. The design iteration is explained here, as well as the evaluation of the design.

Chapter 5 is the chapter concludes everything of the project. It also discusses about the possible future work and current limitations.

Chapter 2

Related Work

2.1. Cooperative Game Design

2.1.1 Design Pattern

There has been increasingly amount of games provide cooperative features. For the traditional multiplayer online games, such as online multiplayer FPS games, players need to collaborate with other players from the same team to defeat the other team, in which players are expected to use team strategy, communication and different approach to complete the task. Collaborative game design also exists in MMORPG. In World of War, a professional called Shadow Priest can help increasing the damage that Warlock (another professional) causes [6]. Moreover, there exists the type of game where player collaboration is mandatory element to complete the game, which is named cooperative game. Unlike the games partially support collaborative game play, cooperation among players is necessary for cooperative game so as to solve puzzles or finish tasks. Rocha [6] sorted out a list of design pattern that are usually used to design interesting cooperative game and challenge archetypes to build cooperative experiences in games.

Complementary is one of the most used design patterns for cooperative game. The purpose of using complementary is to make sure that there is always different feature for characters of different players, so that the players will intuitively seek for collaboration with others.

Synergies between abilities is also widely adapted to collaborative games.

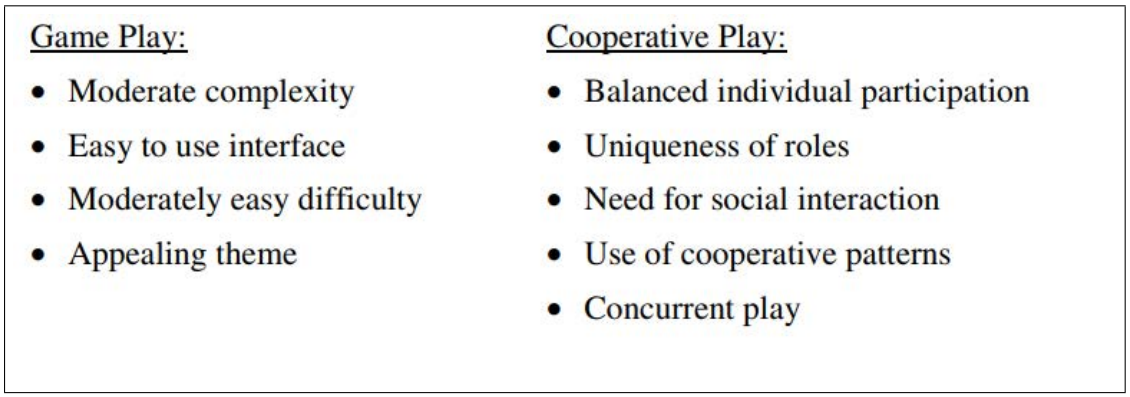

Figure 2.1: characteristic in game play and cooperative play by Nasir [5]

It mainly suggests that the ability of one player should be able to enhance the effectiveness of the ability of the other player, so that the players will actively conduct cooperative play.

Ability that can only be used on other players, means that the ability itself is a sort of interpersonal activity. This feature is usually applied as healing teammates, providing bonus effect, etc. The purpose of this design pattern is to encourage the players to cooperate and interact with other players more often and frequently.

Shared Goal is another mechanism for cooperative play. It forces players to play towards the same target to increase the chances of collaboration.

Setting up synergies between goals and special rules for players in the same team are also consider as cooperative game mechanic. Except for those listed above, Nasir [5] derived the game design characteristics and divided them into two categories: Game play and Cooperative play. The result and classification of the research showed significant partially overlapping, so only part of the result will be taken as reference, which are **balanced individual participation** and **concurrent play**.

2.1.2 Challenge Archetypes

Andrew Rollings and Ernest Adams mentioned in their book of game design [7] that gameplay can be seen as:

"One or more causally linked series of challenges in a simulated environment."

They claim that the design of the game put challenges in front of the player who aims to achieve his or her goal during game play. In addition, they defined a series of types of challenges that are used in current cooperative games. Rocha [6] also have summarized and rewritten the challenges applications in cooperative games in order to assist his research.

Physical challenges reflect the physical norms that happens in the reality. In cooperative games, it is usually used to create puzzles involve with physic that requires the participation of other players, such as moving cubes to the position of the other player in Portal 2 using portal guns.

Coordination, Reflex and Spatial awareness challenge. These are the challenges that are most commonly used in cooperative games, according to Rocha. For example, arranging the team tactics in FPS games or, in Portal 2, coordinating the timing of simultaneously opening a portal both can be seen as coordination challenge. Moreover, designing a game map in puzzle games needs to consider the challenge of spatial-awareness. Again, in Portal 2, discovering the position of where to open up the portals and predicting in which way is the spatial puzzle solved are considered as the spatial-awareness challenge that the developer set up for the players.

As a conclusion, Rocha [6] concluded that the game mechanics can be helpful when designing cooperative game experience.

2.1.3 Related games

Some games also involve with unequal communication although it does not often appear in video game design. Chou [1] stated that this situation usually appears in the real life when people attempt to communicate with people who cannot hear clearly without assists or even animals, but seldom seen in video games. In Chous research, they developed a game involves two players with two different characters. One player plays as a human character, who is able to operate complicate activities, while the other player plays as a dog character who can do simpler but non-replaceable activities such as seeing invisible objects. The study concludes that with unequal communication involved in cooperation game, it can raise the joy and increase many communication opportunities in various methods. For example, the human asked the dog to show him the location of a clue, the dog

turned its body to the direction of the clue, meaning that the dogs orientation is the direction of the clue.

Portal 2 is one of the most famous and iconic game in cooperative game design. It is a first-person puzzle-platform game developed by Valve Corporation. In this game, 2 players each control one of the characters in the game. There are numbers of puzzles or traps placed in each level of the game. The goal for the players is to find a way to reach the exit door that is placed in every level of the game. Players will each control a robot that can generate portal with a portal gun, which is the only ability that the players have and the core mechanism of this puzzle solving game. Portal gun can generate two portals, and the portals are connected in space, which means if a player enters one portal, he or she will come out from the other one [8]. While in the single player mode it is usually the player tries to find a way out using the two portals, cooperative mode often requires two players with four portals to create a way to the exit. Sometimes in order to reach the exit, two players need to move a cube using portal guns to its corresponding location, which requires a strong collaborative method and communication skills. This reflects the coordination challenge of the game, as well as the spatial-awareness challenge in terms of setting up the spatial problems.

2.2. Communication

2.2.1 Social aspect in online game

Multiplayer online games, as a form of networked virtual environment, are paid so much attention in the recent decades. According to Manninen [4], the definition of virtual environment is defined as:

"Networked Virtual Environment (Net-VE) is a software system in which multiple users interact with each other in real-time, even though those users may be located around the world."

Millions of players averagely spend 22 hours a week in Massively-multiplayers online role-playing games to interact with avatars of other players, according to Yee [14]. Multiplayer online games can also be seen as ways of social experience [11]. In the first generation of Networked virtual world, lacked the sociability

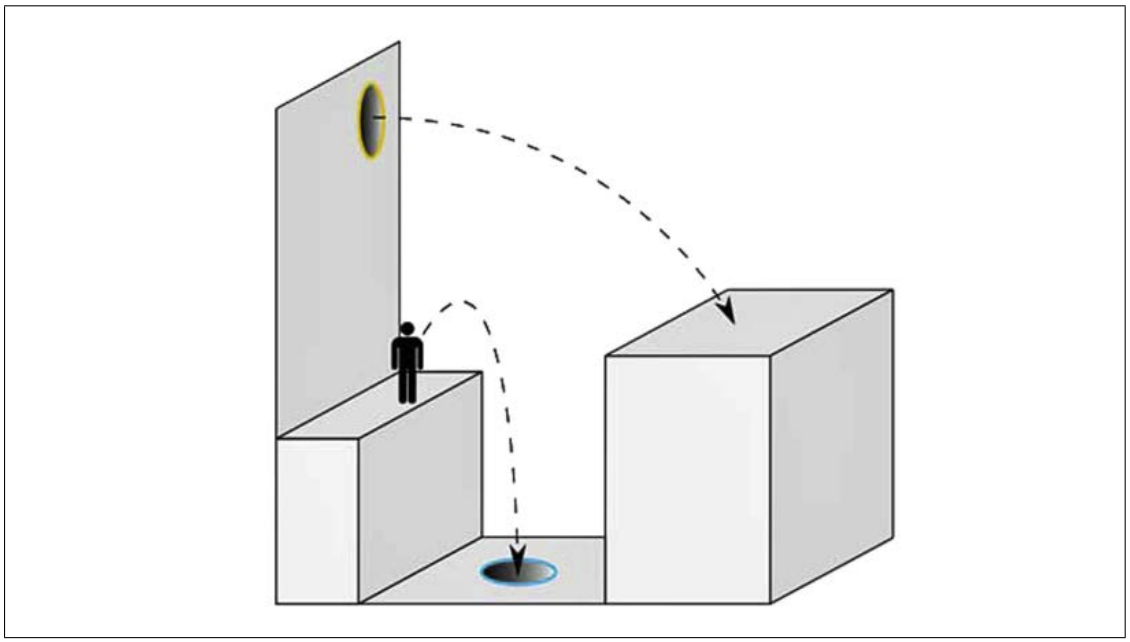

Figure 2.2: Flinging in Portal 2 [8]

during the gameplay because of the limitation in communicating. Texting was not the best way of communication for some cases, since it would be convenient to do in the middle of a fight or battle. Yet these days multiplayer online games have become more enhanced and realistic in socialization and communication thanks to the improved technology in game industry. The study by Manninen shows there is strong social demonstration in current networked online games [3]. Increasingly ways of communication are being introduced to the game players, including voice chat, which is nowadays the most widely accepted way of communication. Speech and body language as various forms of communication allowing a sociable experience for the player to discuss topics with other players. But for the games which contain a limited number of linguistic communication can still have quite some interactions that can be seen as social interaction. Except for voice chat, non-verbal communication can be another way of communication in networked online games. However, even for games that are widely popular around the world at this moment, there still exist very basic problems for players social experience in the games. Even though the players can still find a way around or creating their own way of communication based on what they have currently to communicate

with each other [4]. For every communication method listed above, they all have their advantage and disadvantage while being used in online gaming. The key is reasonable usage and arrangement in virtual environment. The detailed methods are discussed in the following sections.

2.2.2 Voice Chat

The introduce of voice chat to networked online game had brought players a convenient way of interaction with others. It is often seen as an indispensable element for online multiplayer games [11]. Wadley [11] claims that so-called rich interaction media could demonstrate more personal identity and state, i.e. gender, nationality or even educational background, while textual could not present the same amount of information. The experiment conducted by Wadley [11] tried to make clear of the advantage and disadvantage of voice chat in different situation based on different games, as well as the influence on user experience of voice chat in virtual environment. The experiment picked several aspects into account, which are: voice chat with strangers on Xbox Live platform; voice chat with other players in MMORPG (Massively-multiplayer online role-playing game) games; Spatial voice chat transmission in shooter games; voice chat for collaborative team work; voice in anonymous social virtual world; and use of voice chat in moral dilemma challenges for "Dayz". The experiment result showed that voice chat, in general, is preferred by most of players in many circumstances. However, voice chat has its limitations as it was shown in the experiment as well. The author explains that voice chat does not leave any form of record in the game, making it hard to refer again. And due to its characteristics, voice chat does not fit for large scaled group because the situation could become quite messy. Moreover, sometimes voice chat could include background noises such as irrelevant human voice or environmental sounds, which could do harm to communication experience and reduce the immersive experience and privacy. More importantly, the result shows that this form of communication is not preferred by shy-personality people and people who do not want to expose their privacy such as gender, nationality or language. Also, people said hearing voice from reality in game side voice chat could break pseudonymity and reduce immersion.

2.2.3 Text Message

Texting message is the most commonly used communication method for networked online game. However, to play a game and type messages at the same time is considered to be multitasking. It is mostly relevant in First person shooter game genre for texting messages, as it is usually fast-paced and continuous. As Herring [2] stated in her study, text chat messages are usually very short in her sample FPS game, and the words used in the chat are usually abbreviated. This finding could suggest that players who play FPS games usually have shorter time to communicate with other players in typing text message because they have to be aware of surrounding situation in the games. It was also found in her research that averagely 76.7% of chatting content is about the game content itself. Players use text messages to exchange information about the game and to negotiate game strategy. Moreover, player reported to the author that he usually play while talking, and usually get killed while typing., which strongly indicates typing text messages could result in the loss of game experience or draw back in finishing game objective. [2]

2.2.4 Non-Verbal Communication

In real life, it is the body language that conveys the feelings people want to share or express with others apart from vocal expression in face to face communication [10]. According to Thalmann [10], more than 65 percent of the information exchanged in the face-to-face real-life communication is conveyed in the form of non-verbal communication. The author emphasized that only if the developer implement enough non-verbal communication function in the virtual environment system for its user, can the system realize the fullness of interactions happen in the real world. On the other hand, YEE [14] indicates that presence is one key measurement of how real the non-verbal behaviors can be in virtual environments. It means to fully understand the player behavior in virtual environment, it is vital that the players can act realistic enough. Also, by conducting an experiment using a real-life simulation online game called Second Life, the author points out that social interaction in online virtual environment is under the rules of the same social rules as social interactions in the real life, even if there are totally different

way of movement or navigation between the real world and the virtual world. Therefore, this finding can be the theoretical baseline for research and study for social interaction in virtual environment and design for non-verbal behaviors in online virtual environment.

Non-Verbal Communication can enhance the communicative and collaborative activities in virtual environment, stated in another research done by Manninen [4]. If the players can use Non-Verbal Communication to send out messages, then they do not have to be forced to use verbal communication. The research also shows the different classification for non-verbal communication forms in networked virtual environment. In the research he listed 10 kinds of Non-Verbal Communication behavior or interaction, by which he aims to use the conventions and the categories to help future game designers with better Non-Verbal Communication design in virtual environment design. The forms are listed as follow:

Haptics presents the use of touching in game communication. This can be noticed when player avatars try to interact with each other with bodily activity such as hand shake in role-playing situation or body contact in sports games.

Physical appearance indicates the looking or presentation of player avatar. It contains the outfit of player avatar, or the look of the face, body shape, skin color, etc. Difference in appearance could reflect different altitude that conveys messages to other players in the same space.

Kinesics contains all body movements such as gestures or head nods that one uses his/her body to convey messages to others. Gestures are mainly used with arms and hands movements, but head and feet are also seen as important transmitters.

Facial expression is interpreted as different combination of face movements, just as in real life.

Spatial behavior, includes orientation, spatial movement, territorial behavior and such behaviors concern with spatial information, can convey various of information including important spatial information and social information, etc.

Paralanguage means the non-verbal sound information such as roar, screaming, etc. Although paralanguage does not convey any information with words, it still can function as an important vocal communication as it shows emotions, identities, tongues, etc.

Except those listed above, there are Occulesics, Environmental details, Chronemics and Olfactics for the category. They will not be explained in detail as this research does not involve one of those.Yet the design of this research will be based on those listed above, especially kinesics and spatial behavior are referred as the key categories of the design.

2.2.5 Related games

Meadow is a MMO role-playing game developed by Might and Delight. For this game, its players will choose their characters from several animals. The players will interact with each other in the game as different types of animals, and because of that, the players cannot talk to each other using text message or voice chat because they are animals. The only available communication method is using a series of emotes, which is mixed combination use of facial expression and gestures, that are forms of non-verbal communication. Apart from that, the players unintended behavior can also be interpreted as non-verbal communication, such as the players look back to their leader for confirmation, which is spatial behavior in the non-verbal communication category. By this game, some players felt the comfort and cozy of being surrounded by some friendly animal players, trying to achieve one same goal. The interaction with other players using non-verbal communication brought the players with the sense of peacefulness that animals would feel when they work together [9].

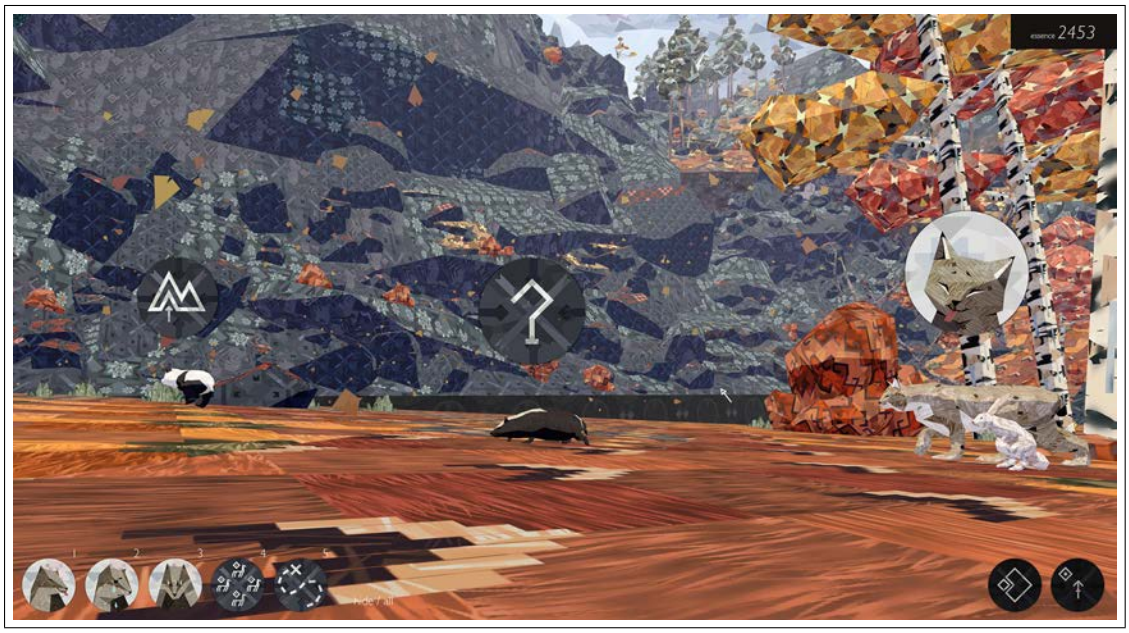

Figure 2.3: Meadow

Chapter 3

Design

3.1. Overview

The Maze Game (hereinafter abbreviated as TMG) is an online collaborative puzzle game designed for PC games. Two players are placed at different locations within and outside of the maze. They cannot visually see each other but can exchange textual and non-verbal communication. Both players hold crucial and unique information to solve the maze, each player holds different information. Various obstacles are designed so that it is impossible for either player to find the correct exit without the aid of the other (to be discussed in details in the following section). The key of the game design is to distribute appropriate amount of information to each player and make the most use of Non-Verbal Communication for the players communication.

3.2. Background

3.2.1 Garry's Mod

The Maze Game is designed based on an existing custom game-designing game called Garrys Mod. The simulation game is developed by Facepunch Studio and published by Valve Corporation. The company is one of the most famous game company, famed for creating The Half Life series, The Counter Strike series and a number of other outstanding games in the world. Garrys Mod uses the Source

Figure 3.1: Garry's Mod

Engine, a commonly used development engine by the designated company. Although Garrys Mod is called a completed game, it is rather a custom sandbox scenario creator. There is no game objective or pre-designed game plot. Players have complete freedom to customize the game as they wish. They could place game items or set up ragdolls to create their own game scene or static environment [12]. If players are not satisfied with the existing database material, they are also entitled to an online community with endless source. The community is formed by all Garrys Mod players. They write their own codes to create new item and environment set up. Players can download all codes for free. What also is very convenient for game mode designers/developers is that Garrys Mod supports both single player mode and multiplayer mode. All that player needs to do is to click on the drop-down panel and choose single player or multiplayer, then the game itself will determine whether to launch the game session locally or start a local/P2P server. Once the server is successfully set up, the host player can invite other players through Steam friend system, or simply wait until someone joins the game.

The author believes that a completed game environment, with logically con-

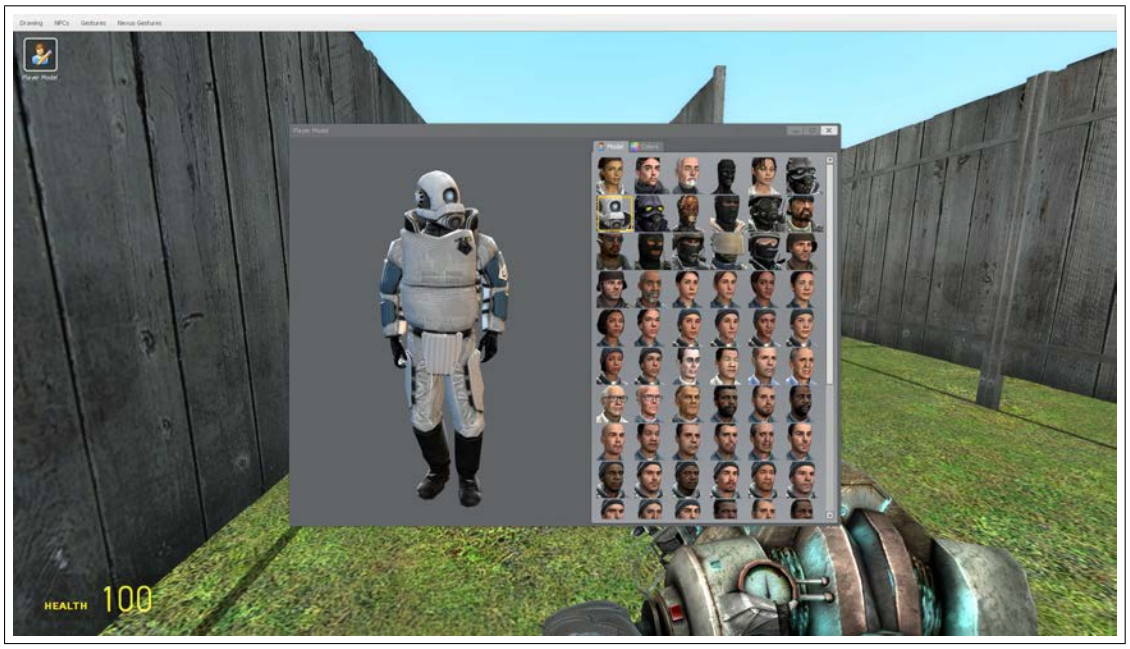

Figure 3.2: Avatar selection panel

nected sound effect, refined imagery, and realistic-looking avatar, is crucial for player immersive experience. However, due to the limited time frame and insufficient coding skill as a one-person team, the author has chosen Garrys Mod that is custom sandbox scenario creator. The simulator has enough freedom that allows the author to insert the non-verbal communication design in the most efficient manner.

3.2.2 Player avatar

Garrys Mod has provided a vast selection of player avatar models. Players only need to press C to invoke the player model panel and select their preferred avatar model. Due to the first-person perspective mechanism, the player himself is not able to see his own avatar model, just as people cannot see their own body in reality. Not only the player can control the avatar to do a series of interaction with the game environment and move around, but also can the other players see his avatars appearance and interactions, so long as they stay in the same virtual space. In this project of game design, a scientist player model is selected to be the

players avatar so as to enhance the realism of players avatar and its non-verbal communication.

3.2.3 Non-Verbal Communication

A series of non-verbal communication commands are provided for the players in the game in order to achieve what the project aims to prove. The game Garrys Mod itself does not support any form of preset of non-verbal communication command. However, a list of non-verbal communication commands add-ons can be downloaded from the Steam Workshop. With the support of the downloaded add-ons, players can invoke the gesture panel for a series of non-verbal communication commands, including agree, disagree, go forward, go backward, wave hand and so on. The gestures are in the form of player avatar animation, which means the player avatar model changes its shape to perform different actions. That says, only if the other player is able to see the players avatar, can he receive the message that the player tries to convey. Every gesture is both complex enough to include enough information and clear enough to let player understand.

3.2.4 Avatar control

Same with other first-person perspective video games, player takes mouse and keyboard as input method. The W, S, A, D keys on keyboard each corresponds to motions of forward, backward, leftward, and rightward. Direction of the motion is controlled by the mouse, in which the user can easily make a 360-degree turn. The player avatar faces the same direction as the mouse points, whether it is vertical or horizontal. Non-verbal communication, that is the main research, is activated via the key Q which opens the command panel. From a drop-down menu, the player will have a list of NVC commands to choose from. Certain actions that are tested to be more commonly used, such as gesture to move forward and move backward, also have shortcut for quick access.

Table 3.1: List of control input method

List of Actions	Corresponding input	Available Character Role
Move	W S A D	Operator
Look Around	Mouse	Operator
Gesture Panel	Q	Operator
Go Forward	=	Operator
Go Backward	-	Operator
Thumb Up and Nod Head	[	Operator
Wave Finger and Shake Head	]	Operator
Dialog Panel	Y	Instructor
Camera Views	NumPad 1 to 9	Instructor

3.3. Game Design Document

3.3.1 Design Concept

The Maze Game puts two players in a collaborative puzzle solving virtual environment. The puzzle is no other than a maze. In order to enter the maze, each player must have his or her own laptop/computer that is connected to the internet. The two players, that is first player and alternative player, are randomly assigned as either the instructor or the operator. Players are presented with incomplete knowledge and ability of the maze. The design prevents individual player to solve the maze without team effort. Instructor owns two items, or more as two super powers, an omnipotent map and a partial omnipotent navigation. The omnipotent map is an overview of the maze. The map sketches out the construction of the maze in a two-dimensional linear method. The second item, or more like an ability, is the access to nine cameras situated in different parts of the maze. Unlike the map, the camera is set at different angles to create visual difficulties for the viewer. The disadvantage for the instructor is that his or her avatar is set immobile. Therefore, the navigation duty falls onto the operator. As the name suggests, the operator is a mobile avatar controlled by the alternative player that is able to move around the maze. In traditional design, the operator should explore and outrun the maze by oneself. However, the maze is purposely designed to have multiple exit. Only the instructor knows the correct exit. Therefore, in order to

truly escape the maze, the operator must rely on the textual instructions from the online chat box with the instructor. As stated above, the instructor has access to nine cameras that provide partial view of the maze. Each of the camera is set to face a different angle which creates a visual distortion for the instructor. The two players must figure out a non-verbal communication to help each other find the correct orientation of the maze. Once the orientation is settled, the instructor can create the most efficient escape route that leads the operator out of the maze. As a happy ending, the operator should find the instructor anxiously awaits at the exit. The two players meet and rejoice.

3.3.2 Background Story

A background story is set for the game in order to give the players a better understanding of the game.

The Operator, Dr. Freeman finds himself lost in a huge maze. He cannot find the way out, even though Dr. Freeman is the designer of the maze, ironically. He does not remember the way out, and the maze is so complicated that he could never find the right exit by himself. Nevertheless, he needs to find his way out in five minutes otherwise he would be late for his meeting. Luckily, his friend, the Instructor is here to help him. With the latest technology in hand, the Instructor is able to get access to all the 9 cameras in the maze. Additionally, he also has the full map of the maze with all the location of the cameras marked on the map so that as soon as he sees the Doctor he will be able to locate him. However, a little set back for them is that the camera can only record the image but not the sound, so poor Doctor Freeman has to use his gestures and body language to show the Instructor what he tries to say and the Instructor will have to try harder to guide him out. Time is critical, let us point Doctor Freeman out of the maze.

3.3.3 Target User

This game aims for video game players, who constantly play games on video game devices. The phrase Gamer might be too wide to determine who is qualified for it (citation Sergio), since people have different perspective towards the standard for gamer. But for this game and its user testing, players should have

basic skill on how to control their avatar and have had experience on networked video game communication. People without much game experience are also welcomed if they are interested in playing this game, but not being experienced in game control might result in difficulty in controlling and less focused on the main content of the game.

3.3.4 Genre and Challenge

The Maze Game is called a game because it brings its player with fun and joy. Yet not only joy that players get from the game, but also challenges and achievements that they may gain in the game. For this game, the Spatial-Awareness Challenge and Coordination Challenge are applied. Games that present the Spatial-Awareness Challenge are games with three-dimensional virtual world that has a set of elements to confuse the players spatial awareness. Spatial distortion can be designed in two ways: present the player with limited information of positioning system or display a non-instinctive geographical view. The challenge being a challenge implies that the limitation does not prevent the players from continuing the game. Players are usually given alternative spatial information to compromise their spatial disabilities. In the Maze Game, the maze is the environment that carries the factor of spatial awareness problem for both players. Maze navigation is one of the classics for spatial disorientation. In a collaborative environment, as the game design is more complex, the problem factor must also be leveled up. According to xxx, two players must have a mutual goal and each holds a different puzzle piece. In order to enhance the problem factor, the author has added in extra cameras around the maze. Each of the camera is set to varied orientation. One of the players is thus given a limited understanding of the maze. The partial information must then be transferred nonverbally to another player, which will then compress the message to a certain degree. Further details will be discussed in the following section. Coordination Challenge refers to the collaboration of players from the same team in a network cooperative game. In most cases, there is also some part of reflex/reaction challenge included. In the Maze Game, the game environment will be set as multi-player mode. Both players are on the same team and must use textual and non-verbal communication to complete the same goal.

usually represent a 3D virtual world that has a quantity of elements that messes players spatial awareness. In other word, player has limited information about the games positioning system or the game has different methodology in presenting the location information. Not being able to recognize the spatial information does not mean the player cannot continue playing the game, instead the game has alternative method in presenting spatial information to compromise the spatial awareness problems. For this game, a maze is to be the factor of spatial awareness problem for both players. Apparently, a maze itself does not provide enough spatial awareness problem, so extra cameras are dispersedly placed in the maze. Further detail of the challenge design will be explicitly explained in later sections. (citation: Andrew Rollings and Ernest Adams on Game Design) As for coordination challenge, its demonstration in most of networked cooperative play is coordinating with the other player from the same team, and that usually includes some part of reflex/reaction challenge. In this game it would be the information exchange between the two players using both non-verbal communication and verbal communication.

3.3.5 Level Design

In general, the design of the level is to design a maze where players need to work together to escape from it. The main focus on the design is to apply various of challenges for the players to solve the puzzle using any sort of method they are granted in the game. The detailed design is listed as follow.

Reason for maze

Maze, as a classical game element, has been widely used in all sort of games. Maze can be seen as a representation of process where user makes decision in every different intersections. Needless to say, if player makes all the correct decisions at every intersection of the maze, then the player will walk out of the maze with the fastest speed. Some maze games may have multiple exits or given limited time to escape. But in most cases, the goal of a maze is to escape from the maze. This is the reason why maze is chosen as the game content, as it provides same goal for all of its players. Maze is also a natural spatial awareness challenge game genre.

Usually the walls are designed to be identical in their appearance so as to cause players confusion in the maze. Just like other spatial-awareness challenge games, player will need assistance from other forms of spatial information to compromise the loss caused by the maze (Citation). Its information incompetence is a perfect characteristic for cooperative game design, which claims complementarity is one of the most used design mechanism for cooperative games (Citation). Therefore, the maze for this game is designed to let two players both have incomplete information about the maze, so as to enforce the players to cooperatively solve the puzzle.

Maze Design

The maze of the game is initially generated by the Garrys Mod Maze Generator that is available on the Steam Workshop (Citation). The Maze Generator has the algorithm to randomly generate a maze with specific width and length. As administrator of the server, one needs choose the desired maze wall material and size of the maze from the Maze Generator panel. One thing to notice is that user needs to input integer value for both the width and the length, which represents the area that the maze should occupy, calculated by one materials length. For this game, the wooden plate material is selected because the wall needs to obstruct both the Operators movement and line of sight so that the Operator will only be able to see whats in his/her current path.

After the maze is generated, the administrator needs to see if the maze has just proper amount of intersections and side roads to increase difficulty and mislead players. Too many intersections will make the game and communication too hard while too little intersections could result in low challenge and bad game experience. One thing especially needs to be paid attention to is that the intersections should be averagely distributed in the maze, not only for general maze design but also for cooperative communication purpose. The cameras and exit routines in the maze are placed based on the difficulty of each intersections it is in charge of, which will be discussed further in details in the later sections.

Sketched Map

While it is designed as the Operator will be wandering inside the maze, searching for his/her way out, the Instructor is designed to be staying outside of the

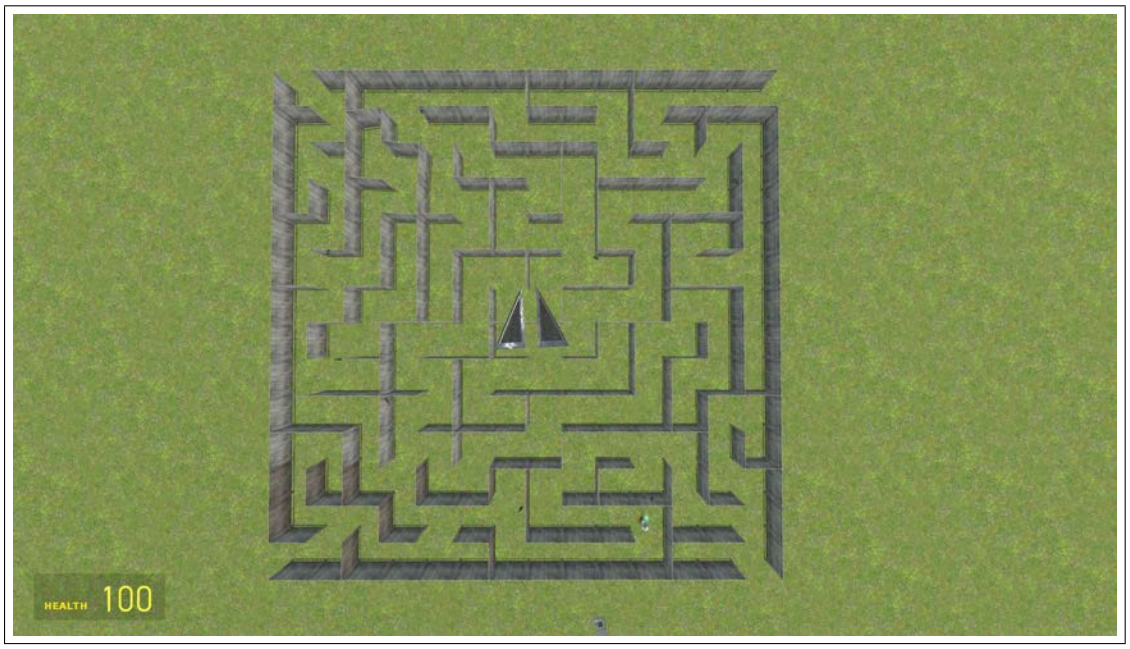

Figure 3.3: Maze in the game

maze to help the Operator escaping. The Instructors avatar will be placed at the exit corresponds to the Operators spawn point at each round of the game, so that as soon as the Operator sees the Instructors avatar he will know that it is the right exit. However, as the instructor is set to be immobile, he cannot control his avatar to move around in the maze with operator. Nevertheless, as compensation, the Instructor is given a sketched maze map that reveals the entire map of the maze. Through the map, the operator will be able to know about every branch that leads to different routine, all the 4 exits, location of all 9 cameras, every path that leads to dead end and, obviously, the correct path that leads to every exit. Noticeably, the numbers on camera icons correspond to the numkey for camera views in the game. But what the instructor will not see on the map are the spawn points for operator and the orientation of the camera. The lacking of the two makes the spatial-awareness challenge and communication need for the Instructor player.

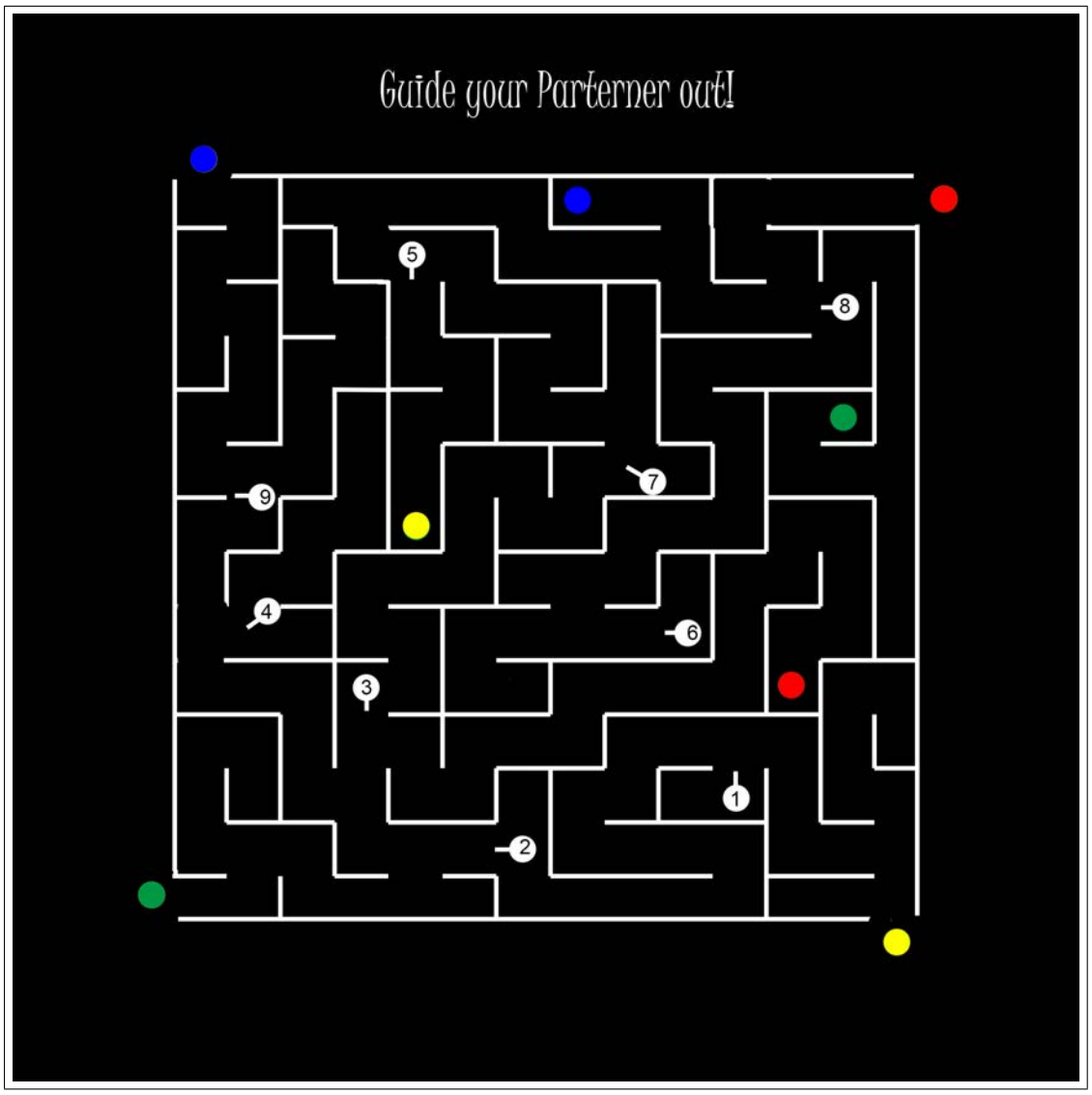

Figure 3.4: Maze design sketch

Spawn point and Exit

As it was discussed above, there are 4 different spawn point for the maze. Depends on different spawn points, players will have different exit for each round. The reason of the design is to prevent players walk their way out of the maze blindly. During the user test for the preliminary prototype, there was this circumstance that one player completely ignored the instructions from the Instructor and found his way out of the maze blindly. It is also noticeable that there exists a law for maze that would 100 percent work for maze: always following the left wall. Not only to prevent the players from conducting cheating or drift away from instructions, but also to provide the possibility of multiple times of playing. It is very likely that players can remember the routine to escape after playing the game for once. Thus, implementing long-lasting feature and various routines is important for this project. Further design detail on multi-routine will be discussed in Map section.

Camera

Camera is another tool that pre-existed in Garrys Mod. It provides players extra views in the world. Normally, players are only allowed to have one view, which is the players avatar first-person view. With the added cameras, players can look through the cameras even if their avatars are not in there. There are 9 cameras placed in the maze in total, most of which are placed at intersections or near intersections. But some of the cameras are placed in the dead ends and near the exits. This is used to giving players a chance to correct potential mistaken-communication that could lead the Operator to wrong branches.

The figure above is the map of the maze, which is designed for the Instructor. As it can be seen in the figure, the black dots indicate where the cameras are placed in the maze and the black lines represent the walls of the maze. As Instructor, the player can press any key on number pad of keyboard from 1 to 9. The numbers indicate which key the Instructor should press on. As an example, if the Instructor player presses key num5, the players screen will switch from the avatars first-person view to the view of number 5 camera, which is located near the west wall of the maze. Meanwhile, if the Operators avatar positions within the range of camera number 5, then the camera will capture the Operators move-

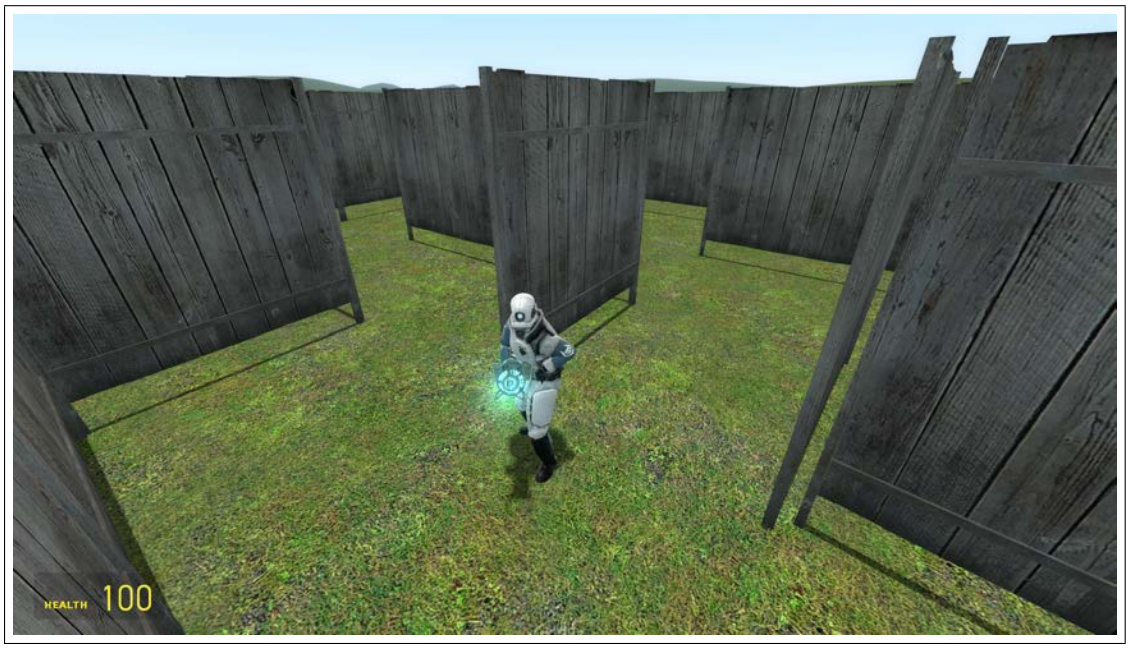

Figure 3.5: camera view for camera number 5

Figure 3.6: Operator view for camera number 5

ment so that the Instructor will be able to see it. In addition, the cameras exist in the game as visible entities, so the Operator is able to see the cameras if they slightly raise their view. Based on that characteristic, the cameras can be seen as the checkpoints in the game. If the Operator gets lost in the maze and do not know which way to go for the next, one can walk around to find a camera. The operator can interact with the Instructor through the cameras. In the early design stage, the author considered about whether to put mark the number on camera icons. It would have been an extra game content and spatial-awareness problem for its players. However, after a few early user testing, the designated content would greatly increase the difficulty of the game, making it almost impossible to finish the game in the given time. Thus, instead of not marking the number of the cameras, it is determined not to draw out the orientation of the camera. The Instructor will only be able to see where each camera with number are located in the maze, but not able to see which way the cameras direct. As for the orientation of cameras, they are mostly placed on the top of walls, each of which facing to a different direction so as to creates a visual distortion for the instructor. The instructor has to find the identical parts of walls and paths shown in the camera with the map that he/she has in hand. Presumably, this is going to test the players spatial-awareness ability by switching the sketched map view to actual game graphics and distort the orientation of the cameras, which are seen as methods of creating spatial awareness problem.Besides, in communication-wise, the existence of cameras allows limitation on players communication. The Instructor will not know exactly where the Operator is until the Operator appears in a camera, so the Instructor player cannot tell the Operator where to go in this case. Likewise, because the Operator is only allowed to use gestures as communication method, he/she cannot send any message until arriving at the camera position, where the Instructor can see him/her. In general, the camera features the main challenge factor in the game, creating the important puzzle factor for the players. It also functions as the mediator of the two players communication and visual appearance.

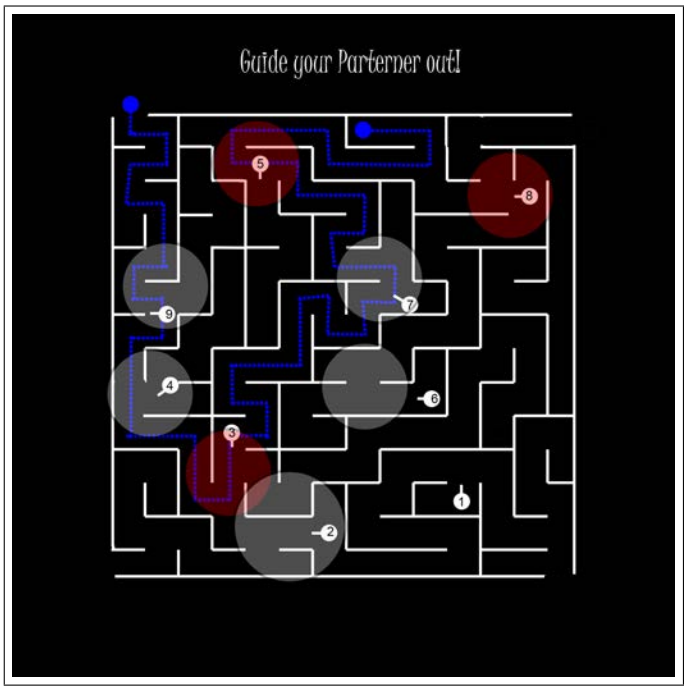

Figure 3.7: Routine for player spawn in blue point

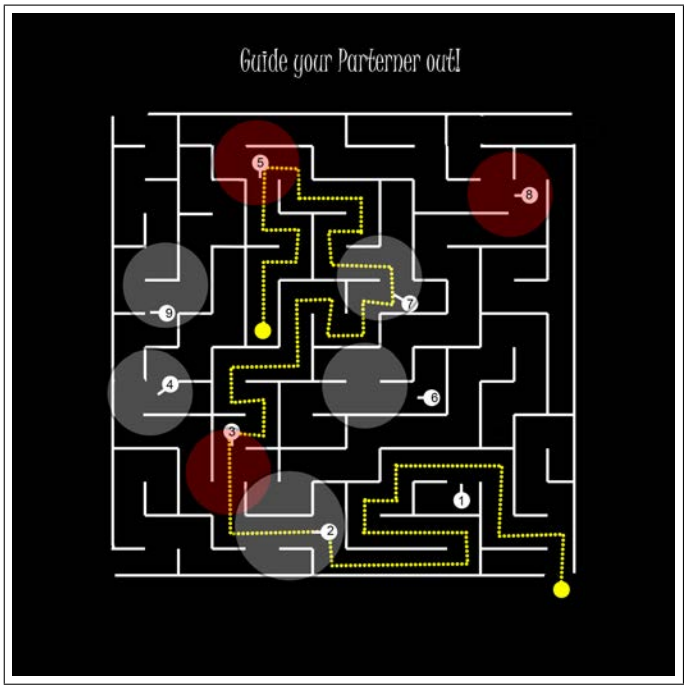

Figure 3.8: Routine for player spawn in yellow point

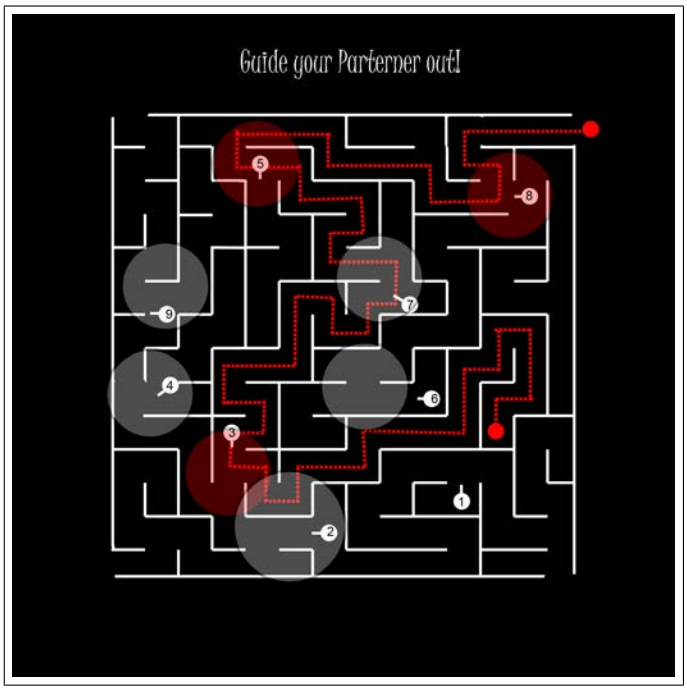

Figure 3.9: Routine for player spawn in red point

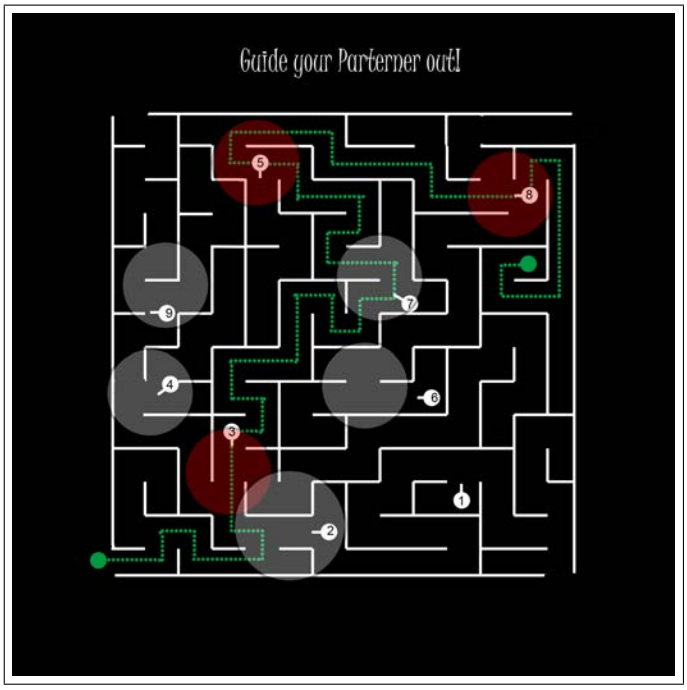

Figure 3.10: Routine for player spawn in green point

Map design

As it was briefly described above, the map of the game is consisted by a maze, which is initially generated with the addon Maze Generator for Garrys Mod. However, in order to implement multiple spawn points for the Operator, there has been a few alterations for the maze. Firstly, the initial maze only has 2 gaps in the northwest and southeast corner of outer wall of it, each of which represents the entrance and exit of the maze. For increasing the long-lasting game experience, two more maze exits are created in the rest of the corners and the entrance of the maze is also seen as one of exits for the maze. Instead of being spawned at the original entrance, the Operator will be spawned somewhere inside the maze. The locations are shown in the following figure. In the design period for spawn points, one of the most important aspect is to balance the four different spawn points so that no matter where the Operator is spawned, it is approximately going to cost the same amount of time and be the same difficulty. In order to achieve that, each of the spawn points will approximately have the same distance to its corresponded exit, as well as the same amount of intersections and cameras. The distance from spawn points to their corresponding exits is measured by calculating how many units of wall are between them. The detailed design can be seen in the following figures. The red circles in the figures suggest high difficulty intersections for the players, mostly over 2 branches in the intersection. The grey circles in the figure mean normal difficulty intersections, which usually contain 2 or less branches. Most of the difficult areas are covered by cameras so that players have enough opportunities to communicate and correct their mistakes.

In addition, there has been a compass function designed for the Operator. The compass, ideally, should be an item that Operator holds in hand. However, due to technical difficulty, the design has been changed to an arrow indicator that appears well above the maze so that as long as the Operator raise the view he/she will be able to see it. The arrow will not change its direction nor position while the Operator moves and it will always point to the north. Since the compass is placed well above the maze, there is no way that the Instructor can see it through the camera. The compass can help the situation when the Instructor gets confused about current position, so that the Instructor could ask the Operator to point out the north direction.

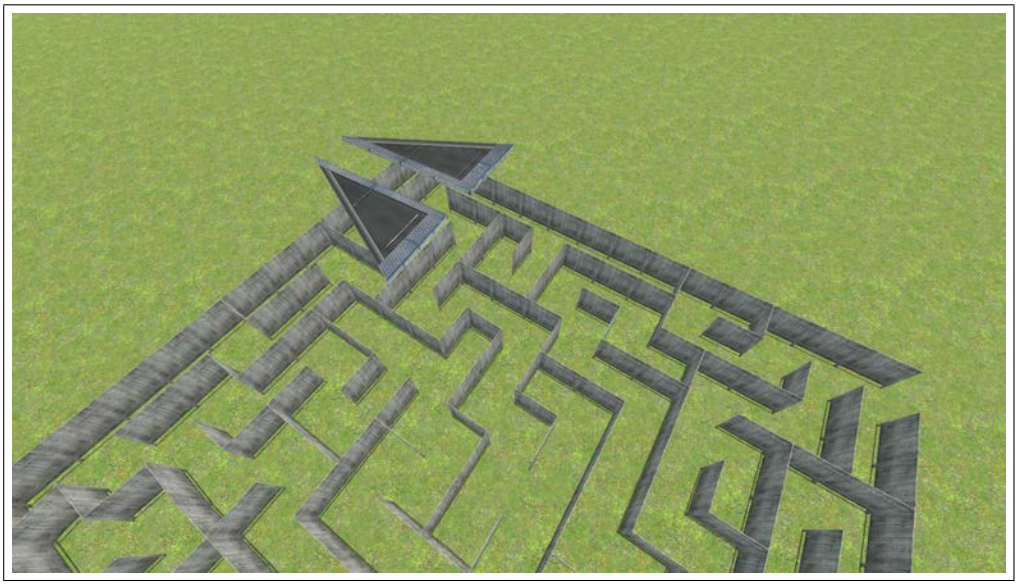

Figure 3.11: Compass

Cooperative Design

The cooperative aspect of the game is designed based on the finding of the research done by Rocha (2008) and Nasir (2013). This game mainly focused on using Shared Goal and Complementary to create the necessary cooperative gameplay. Firstly, in terms of spatial behavior, such as moving around and look around, the two characters are given different level of access to this ability. The Operator, who is designed to walk inside the maze, can walk the avatar around in the maze, and also is able to see the visual information inside the maze directly. The Instructor on the contrary, is not allowed to move the avatar in the maze. What the Instructor is able to do is looking through the 9 cameras with designated view at the certain locations inside the maze. Although the Instructor is not able to walk in the maze by himself or herself, the Instructor can look up the correct routine to the corresponding exit on the map he/she is given in reality side. Once the routine is confirmed, the Instructor can guide the Operator to walk in the certain direction. The expected game play reflects the use of complementary in the abilities of different players, as it would not be possible to finish the game without collaboration in navigating and actual movement. It can also reflect the use of share goal, since both players have the goal of getting the Operator

out of the maze from the correct exit, yet each of whom achieves it in different approaches.

Nevertheless, the process of guiding can hardly to be flawless. During the communication for navigation between the two players, it is expected to have inaccurate communication occurs. Normally, if one player says go to the right direction, the "right direction" could be fairly ambiguity, since it depends on the position and orientation of the listener, and also can be misinterpreted as "correct direction". In this game, it is designed for the Operator to use non-verbal communication to confirm the direction where the Instructor indicates, while the Instructor uses text message to guide the Operator player. This design method of communication implements the Unequal Communication design that is mentioned above and used by Chou (2016). It is aimed to increase the joy of the game as well as enhance the immersion and realism due to the story of the plot.

The Non-Verbal Communication genres that are used in this game contains Physical Appearance, Kinesics and Spatial behavior. Facial expression and Paralanguage is quite concern with this project but yet to be implemented in current design and will be discussed in future work section. Physical appearance is implemented in the form of avatar outfit for this game. Kinesics, as one of the most important form of Non-Verbal Communication, exists in this game in forms of pre-programed gestures and head movement animation. Spatial behavior is determined by players avatar movement and orientation, etc.

When the Instructor sees the Operator through the camera, the Instructor then look for the position of the specific camera in the map. He/she then finds out the position of the Operator and uses text message to guide the Operator which branch that he/she should go. Expectedly some players who play as Instructor will use phrases or words that are ambiguous such as "look at that way" or "go straight" or "look at you left side". This can cause misunderstanding to the Operator player. The solution here is to simulate the way of responding in real life, where people point to the direction and say "is this the way you want me to go?". Here in the game, there are in total more than 10 kinds of non-verbal communication gestures supported. For example, the Operator can choose from the drop-down menu or press the shortcut keys to perform "point forward", "wave

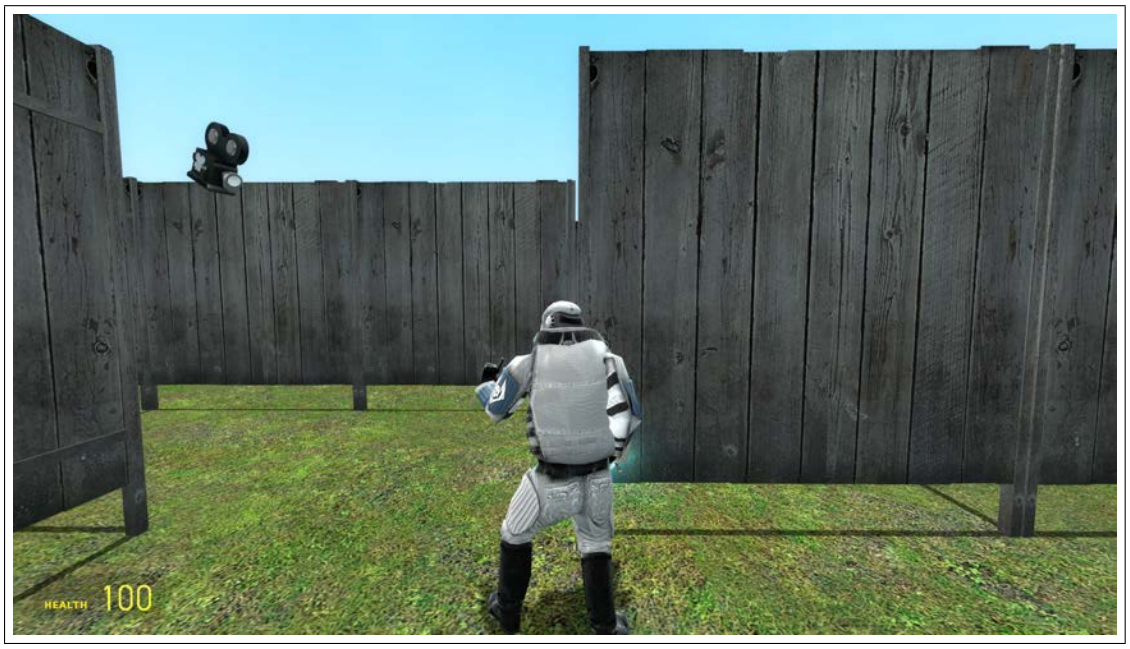

Figure 3.12: Avatar using thumbs up gesture

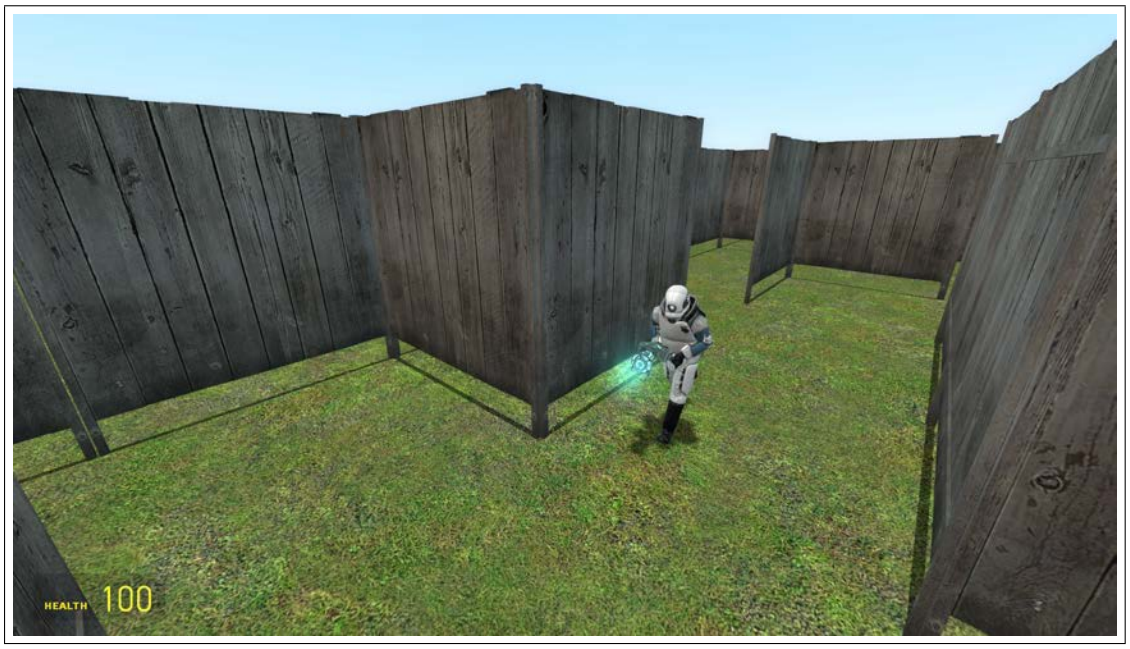

Figure 3.13: Avatar moves in the maze

to come back", "nod head and thumb up", "shake head and wave finger", etc. In many circumstances, the non-verbal communication gestures are expected to function as an independent communication method and be efficient in supporting communication. In the situation when the Instructor texts ambiguous message such as "go forward" or "look on you left side", the Operator should use the point forward gesture to confirm the direction with the Instructor. If the Instructor sees the activity, he/she can simply type "yes" or "no" using text message to tell the Operator if he/she is pointing to the right direction. The gesture "wave to come back" has similar meaning with the "point forward" gesture but in the opposite direction, so that the Operator can point to his/her back direction but meanwhile being able to see the camera. In the circumstance where the Operator followed the instruction or guidance from the Instructor but found out it led to a dead end in the maze, the Operator can use "shaking head and wave finger" gesture in front of a camera to send message to the Instructor that "the instruction was incorrect and led to a dead end", but it can also be combined with "thumbs up and nod head" gesture to respond the Instructors binary questions. For example, the Instructor may ask the Operator to confirm if the branch in front of him is blocked or not, so the Operator needs to respond to the Instructor with either positive or negative respond, in which case, the gestures would be perfect solution. Even though the spatial behavior type of Non-Verbal Communication is not specifically designed in this game, there still exists several expressions. The Operators orientation is one of them, so does avatar movement. It can partially demonstrate to the receiver about spatial information.

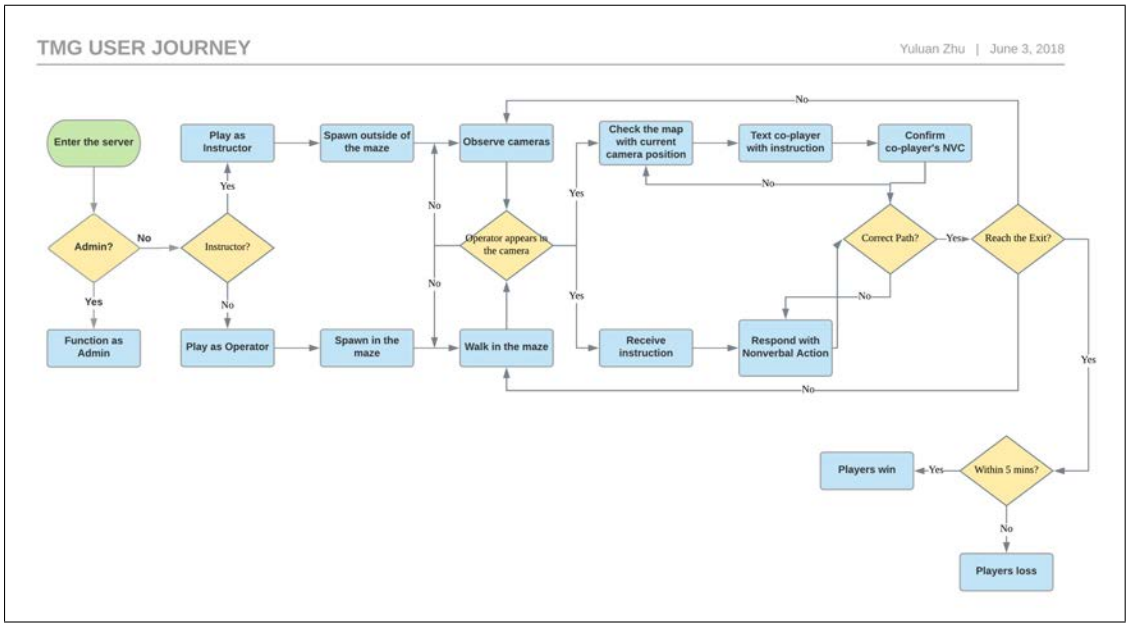

Figure 3.14: user journey diagram

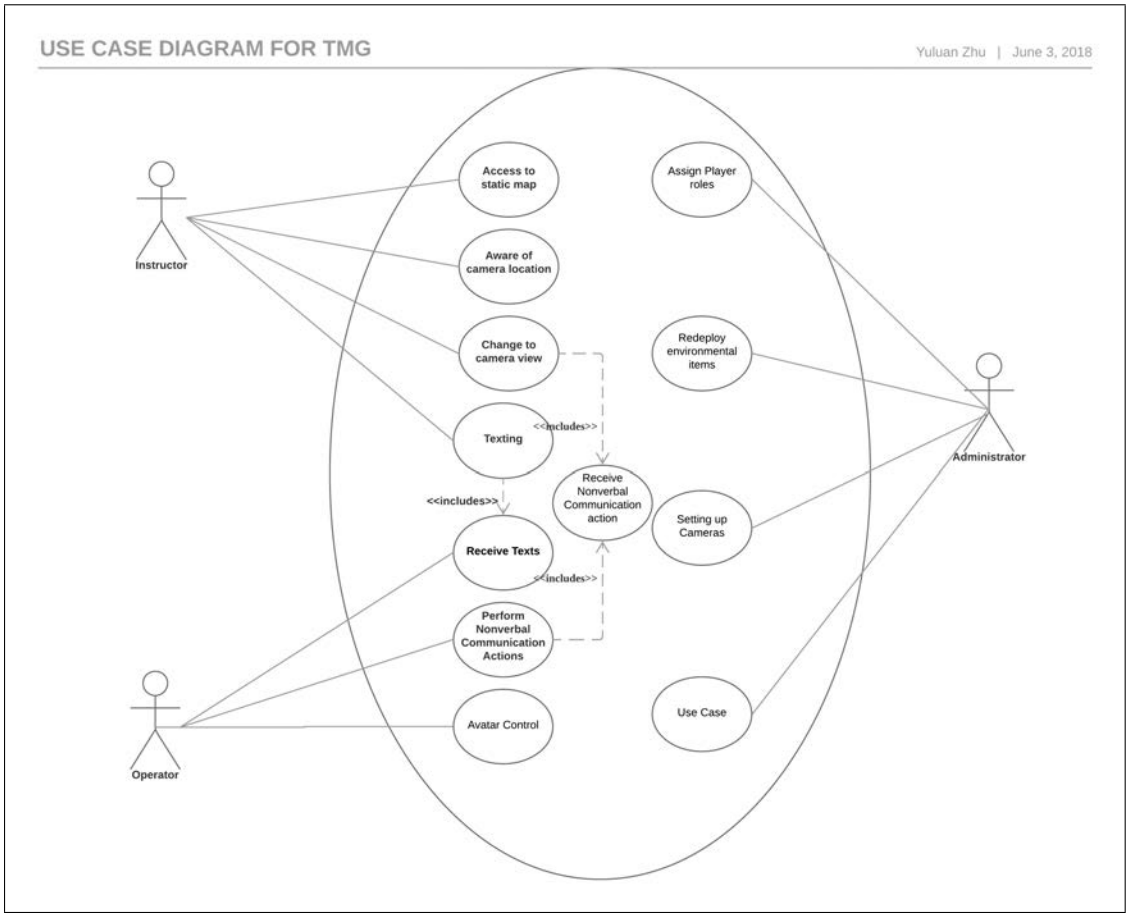

Figure 3.15: use case design

Chapter 4

Implementation and Evaluation

4.1. Design Iteration

4.1.1 Preliminary Prototype

The first attempt to implement the design of the game was vastly different from the final implementation of the game. In the preliminary implementation, two players are given different tasks and different approach to finish the tasks with the final version of the game, despite the goal for the two players is as same as the final version. A transparent platform is placed on top of the maze. On the platform, the Instructor stands upon the it and is able to see the whole maze in real time. While the Instructor is located on the platform above the maze, the Operator is spawned at the entrance of the maze where its located at the bottom-right corner of the maze. The task for both the players is to find a way through the maze to the exit of the maze.

Inspired by the cooperative play mechanics derived by Nasir (2013), the preliminary prototype aims to achieve complementary and concurrent play by separating the two players in space, limiting the availability of both players in certain abilities. For the Operator, without knowing the shape and map of the maze, it is fairly difficult to walk out of the maze alone. As for the Instructor, the Instructor is limited in moving ability that the player is only able to move within the platform. Thus, the game mechanism forces the Instructor to use non-verbal communication gestures to guide the Operator from above. The Instructor points

Figure 4.1: players communicating through NVC

to the directions where the Operator ought to go so as to find the exit. In terms of the Operator, the player needs to constantly raise the view to see the non-verbal communication that the Instructor performs. Meanwhile, the player needs to respond to the Instructor as well using non-verbal communication.

4.1.2 Preliminary Prototype User Feedback

The preliminary prototype was tested by 4 users in order to collect preliminary user reaction towards the design. The 4 users formed 2 groups and conducted 2 user tests. As the result of the user test, two players who played as Operator, reported that it was not very pleasant game experience. What particularly mentioned by the 2 players is that raising up the view to look at the guidance from the Instructor caused dizziness after playing the game. As a result, the 2 two players did not feel the game experience is very joyful. What possibly resulted from the dizziness was that the 2 players could not clearly receive the communication from the Instructors, which could also because of the distance between the two avatars. For whichever reason, it has shown the need of improvement for the Operator side

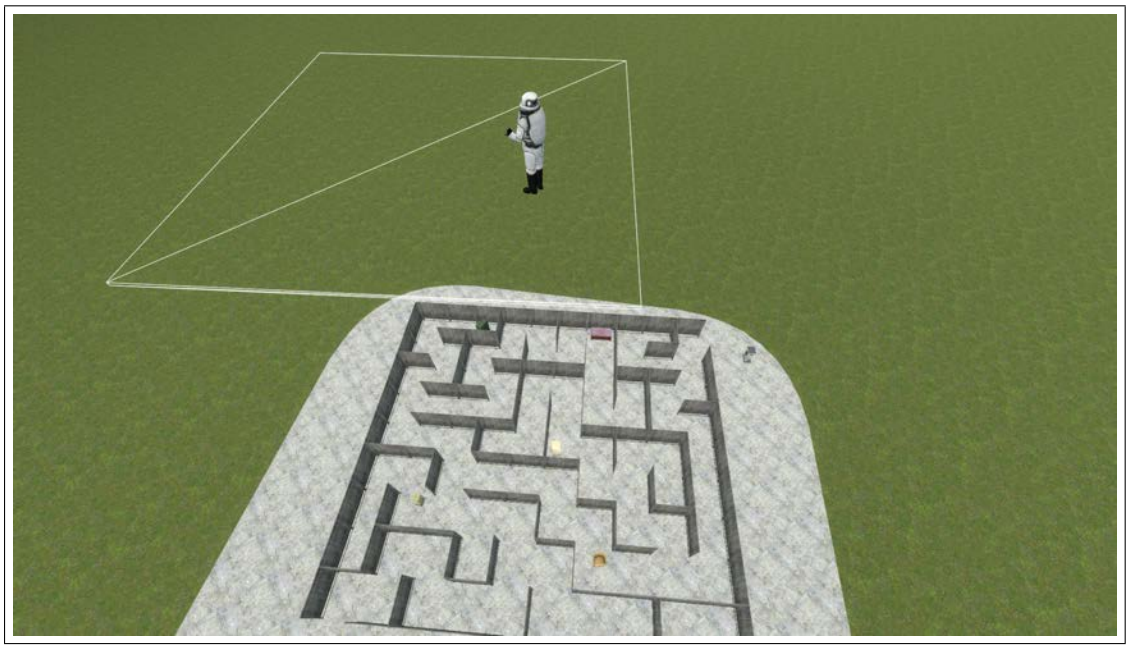

Figure 4.2: Instructor on the transparent platform

game play. On the Instructor side, the two Instructor players also responded with their concern. Same with Operator, they talked about the non-verbal communication did not supported the Operators with navigation. More often happened in the game was that the Operator did not look at me when I used the gestures to guide them! one of the Instructor replied with.

4.1.3 Modified Preliminary Prototype

With the received user feedback, Modification is made to the preliminary prototype. The Instructor is put down onto the ground to join with the Operator. Instead of seeing the entire maze from above, a camera is placed on the top of the maze, which can be accessed by the Instructor by pressing numpad 0. Different from the preliminary prototype, this time the Instructor can use non-verbal communication in front of the other player. In addition, the Instructor players are asked to walk behind the Operators avatar to avoid Operator simply follows the Instructor. In this form, the Instructor will walk behind the Operator and give instructions to the Operator when needed.

Figure 4.3: Instructor showing the direction to the Operator

4.1.4 Modified Preliminary User Test

There are 10 participants, who are postgraduate students from the Graduate School of Keio Media Design (KMD), for the testing of the modified prototype. The tests were taken with every 2 participants forms a pair of players, where the players need to play the game given the limited of time which is five minutes. After the players finish one round of game, they were asked to fill a survey questionnaire to evaluate their game experience. Meanwhile, while the players were playing the game, the gameplay process of the Instructor was recorded using Nvidia Game Experience in-game Recorder in order to review the game detail afterwards. The questionnaire includes questions regarding the joy of the game, understandability and the usability of provided non-verbal communication gestures, subjective communication accuracy from players point of view and helpfulness in gameplay.

The result showed that prove of the modified preliminary prototype has partially reached the target but reflected the problem of the design in the same time. 6 players out of 10 did not finish the game in the given time. 8 out of 10 participants rated their communication below 3 out of 5, which means majority of the participants did not think they communicated well with non-verbal communica-

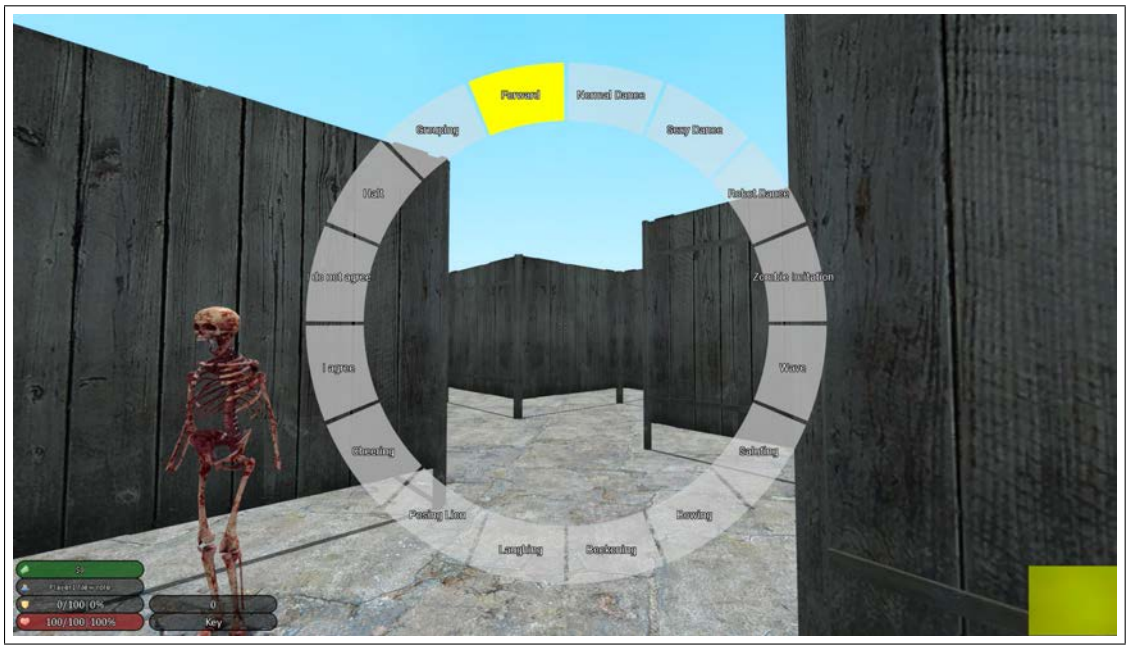

Figure 4.4: Instructor picking the right gesture

tion. In terms of feasibility of non-verbal communication in the game, there is no participant thinks that the non-verbal communication gestures have provided with enough actions that they need. Moreover, the participants rated the helpfulness of non-verbal communication in the game rather evenly, 5 participants gave the rating over 3 (including 3) while the other 5 rated under 3. The result of understandability evaluation shows even distribution too, as 4 people gave rates below 3 and 3 people gave rates over 3 and the rest gave rates of 3. Last but not least, the participants mostly gave a high rating to the joy of the game. 7 participants rated over 3 on how much they enjoyed the game experience, while the rest 3 rated lower than 3.

In addition to the surveys, some players gave feedback after they played the game. One player has doubted the design of the game, claimed that in the real game play the Operator does not have to wait for the instruction but let the Instructor lead the way. The other player responded after playing the game that it is unnecessary to follow the instruction from the Instructor as he could have walked out of the maze by blindly walking or always following the left wall. Some other players who played as the Operator claimed that they did not have much work to

do, because they simply only need to follow the instruction and walk but not using any non-verbal communication. The design of the non-verbal communication ring possibly lags the efficiency of using non-verbal communication gestures, as it was observed during the gameplay that some players had difficulty in clicking the right gesture.

The result of the survey suggested that the preliminary design of the game did not provide better understanding in the non-verbal communication, as the players did not think they communicated well by using it. However, the evenly distributed rating of understandability and helpfulness of non-verbal communication in the game suggests that there is room for improvement. With a better structured and designed gameplay, it is very likely that the non-verbal communication actions can function well and support the communication needs. Also, the data that majority of the players enjoyed the game experience shows the potential of the game in enhancing game experience and joy, and it is motivative for further modification on design.

4.1.5 Final Prototype

With the findings and feedbacks from the modified preliminary user test, the final design was derived to fix the problems and make improvements.

Firstly, the design of both players walk in the maze in the modified preliminary prototype does not reflect the complementary mechanism in cooperative play, for the Instructor can always see the branches and surroundings of the Operator. Thus, the game was then changed to using cameras to provide limited view and accessibility to the maze for the Instructor. Comparing with the last version of prototype, the final prototype ensured that the Instructor is not aware of the surrounding and the location of the Operator, in which case non-verbal communication is necessary for both the players to finish the game, preventing the possibility of the Operator simply follows the Instructor. The design of camera also provided the rationality and background information for the reason why the Instructor has to use non-verbal gestures instead of verbal communication, which is because the camera does not transmit sound information but visual information.

Secondly, the dynamic camera view in modified preliminary prototype shows real time maze map, in which the Instructor can see where the Operator is. With-

out any difficulty, the Instructor can easily point out where the Operator should head to. Therefore, in the final prototype, the dynamic camera view is changed to a piece of paper with scratched map on it. The Instructor has to find out where the Operator is by check the cameras so that he/she can read the non-verbal messages from the Operator who stands in front of the cameras.

Thirdly, the maze was changed to have four different exits instead of having one entrance and one exit, eliminating the possibility of blindly trying the way out. Also, the Operator spawns at one of the spawn points in the maze. In this case the Operator has to find a camera to communicate and the Instructor will not know the location of the Operator.

Fourthly, the Operator now can directly use non-verbal communication using keyboard shortcuts. It was observed in the previous user test that players struggled to click on the gestures and wasted a lot of time on figuring out the interface. For this final prototype the most used four gestures are bind with shortcut keys, so long as the player clicks the keys the gestures can be triggered immediately.

4.1.6 Final User Test

Qualitative Data

24 participants in total are counted for the final prototype user test. Similar with the preliminary test, all the participants are students from Keio Media Design, and are divided into pairs of 2 players. The participants are randomly assigned with roles in the game and are given a participant number for post-game survey with anonymity ensured. Both the Instructor and the Operator are given a paper of user manual, which gives the players the basic information and guidance to play the game. Only the Instructor gets a paper of map of the maze, which has the structure of the maze and location of the cameras illustrated on it. During the gameplay, the players are not allowed to talk with each other in reality but to communicate in the game using supported communication methods. The game is timed and the players are asked to finish the game in 5 minutes. However, the players are allowed to continue even if they exceed 5 minutes until the timer reaches 8 minutes. The process of game play is recorded using Nvidia Game Experience just as last user test. After finishing the game, the players are asked to

fill out a survey questionnaire to rate their game experience. The Operator and Instructor are given different survey questions regarding their role responsibility and game experience. The questions for the Instructor are mainly about the understandability and thoughts on received non-verbal communication and the overall game experience. On the Operators side, the questions are more about the helpfulness on non-verbal communication to the gameplay and navigation. Most of the questions in the questionnaire are in the form of rating, which means the participants need to choose from 1 to 5 as the rating for the asked evaluation, where 1 means strongly disagree and 5 means strongly agree.

Table 4.1: Instructor user test result

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Average
Understandability	0	3	1	7	1	3.50
Level of Information	0	4	3	2	3	3.33
Response Efficiency	0	2	6	1	3	3.41
Helpfulness	0	1	4	4	2	3.64
Difficulty of locating the Operator	1	2	2	5	2	3.42
Improvement on understanding of NVC	1	2	3	4	2	3.33
Joy	0	1	1	6	4	4.08

The result of the survey showed player's attitude on feasibility of the game and the rating on game experience. In total, there are 80 percent of participants did not finish the game in 5 minutes, although there are some of them finished the game just out of 5 minutes. More than half of the participants finished the game before their games are forced to stop when 8th minute reaches.

On the Instructor's side, there are 9 out of 12 participants rated the understandability of non-verbal communication over 3, in which there are significant large amount of people rated 4 on the understandability. In terms of level of information that the players received in non-verbal communication, 8 out of 12 of the participants think it provided enough information, although 3 of them are neutral on this question. Significant large number of participants is found again who rate 3 towards the efficiency of non-verbal communication the Operator uses to give response. Apart from people who chose 3, there are slight more people who think the response was efficient than those who think it is inefficient. For

helpfulness of non-verbal communication in giving guidance, majority of participants chose "helpful" and "very helpful". Noticeably, there is only 1 participant who thinks it is not helpful in guidance. The following 3 questions are used to rate the overall game experience of the instructors. To evaluate the difficult and challenge of the game, the participants are asked to rate the difficulty of locating the Operator. 9 of 12 participants rate the difficulty over 3 and 7 of the 9 people chose 4 or 5, which means fairly difficult. 9 of 12 participants think that their understanding of non-verbal communication was improved after playing this game. Vast number of players highly rated the joy of the game, only 2 of 12 players did not rate the joy over 4.

Table 4.2: Operator user test result

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Average
Clearness of communication	1	2	5	2	2	3.17
Adequacy of NVC	1	3	2	4	2	3.25
Helpfulness	0	0	4	3	5	4.08
Difficulty of Finding the way	0	2	3	3	4	3.75
Improvement on willingness to use NVC	0	3	2	3	4	3.67
Joy	0	0	3	3	6	4.25

On the other side of players, the Operator players, averagely think that the text guidance from the Instructor is clear, but most rates are at middle point of rating. The ratings for "adequacy of non-verbal communication function" are widely vary from 1 to 5, but the biggest number for count is 4 people rated 4 for the question and 8 people rated over 3 (including 3). Similar with the situation for Instructors, all of the participants think their non-verbal communication has improved the accuracy of the guidance from Instructors. In terms of game play, most of the participants felt it was rather hard to find the right way with the guidance from Instructor, but it was still fun to play the game by all the participants. The participants showed their willingness to use non-verbal communication more often in future game playing.

Except from the evaluation of both roles, there has been another comparison test to see the difference between the result of Non-Verbal Communication and the result of verbal communication. In total, 10 participants are divided into pairs

of 2, each pair were asked to play the game twice with different approach. For the first round of the game, the participants were restricted with textual message while communicating in the game. As for the second round, the operator was told to only use Non-Verbal Communication to communicate with the Instructor. The evaluation standard for both roles are the same with the standard for previous test. The results are compared using their calculated average value, which are listed below.

Table 4.3: Comparison test result

	Textual Communication	Non-Verbal Communication
Clearness of communication	3.5	4.1
Information Adequacy	2.8	3.6
Helpfulness	3.1	3.8
Difficulty	4	3.8
Joy	4.3	4.4

The result of comparison has shown that Non-Verbal Communication has a significant advantage in the result of the survey, with each parameter has better statistic than textual communication.

Quantitative Data

The Quantitative data source is the recorded video for the gameplay process. The video clips from the comparison test are used for this evaluation so as to compare the success rate for both communication method. By analyzing the accuracy and efficiency of the communications in the game, the result can be used to support the hypothesis. During the Non-Verbal Communication game play, the Operator need to point out the direction if he/she is not sure about the direction, then the Instructor needs to confirm its correctness. And in the verbal communication game play, the players need to use in-game textual message to exchange their words. After analyzing the video clips, the player communications in game is divided into several different categories, which are "Successful NVC", "Unsuccessful NVC", "Successful verbal communication" and "Unsuccessful verbal communication". The standard for successful or not is determined by whether the Operator has went to the right branch while in an intersection. Using NVC

gesture will give player a chance to confirm the correctness of the chosen branch. Noticeably that the process of using gesture to convey the direction of north in the map is also considered as a part of non-verbal communication, which means if the Instructor guides the Operator after getting the information of north direction, it will be counted as a successful NVC. The video clips showed approximately 47 communications in total, including operators chose to use non-verbal communication and operators did not use non-verbal communication. Due to there was no NVC in the first round of the game, the number of both successful NVC and unsuccessful NVC are 0. For the NVC round, if the operator does not respond to the Instructor using NVC, then it is counted as textual Communication. The result is listed in the table down below.

Table 4.4: Video clips analysis

	Textual Communication	NVC
Successful NVC	0	16
Unsuccessful NVC	0	1
Successful Textual Communication	13	6
Unsuccessful Textual Communication	10	1

The game play process is timed in 8 minutes. As it is described earlier, players who cannot complete the game within 8 minutes will be forced to stop playing. As the result, the following chart shows the game finish rate for each communication method in 8 minutes.

It can be clearly seen in the chart that only 3 pairs of players finished the game within 8 minutes while playing in the NVC round. All pairs of players did not pass in 8 minutes while playing in the textual round.

4.2. Discussion

The most significant finding of the user test for the final prototype is that most of the participants enjoyed playing the game. After evaluating the result of the question about joy of the game, there is only one player who rated the joy of the game below 3. By calculating the average value of the data collected, it can be seen that the average values of enjoyment for both groups of players are above 4, which

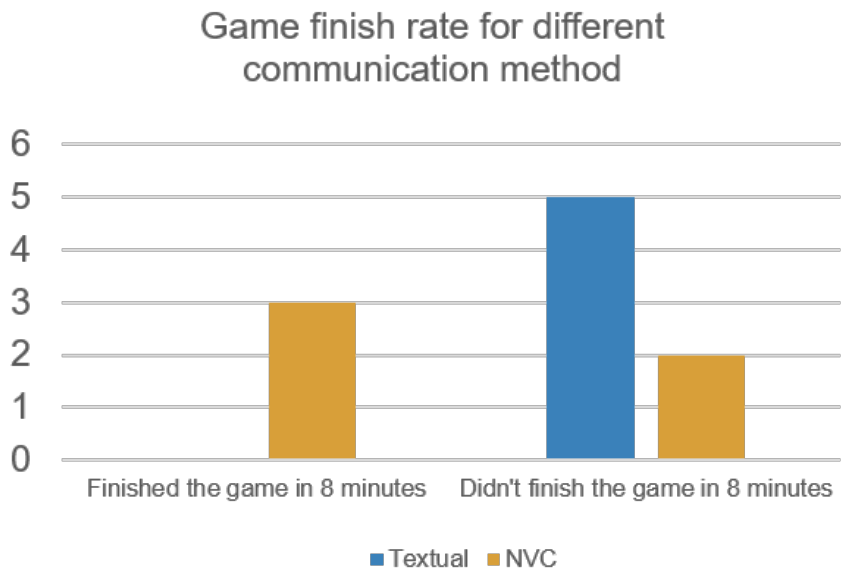

Figure 4.5: game finish rate in 8 minutes

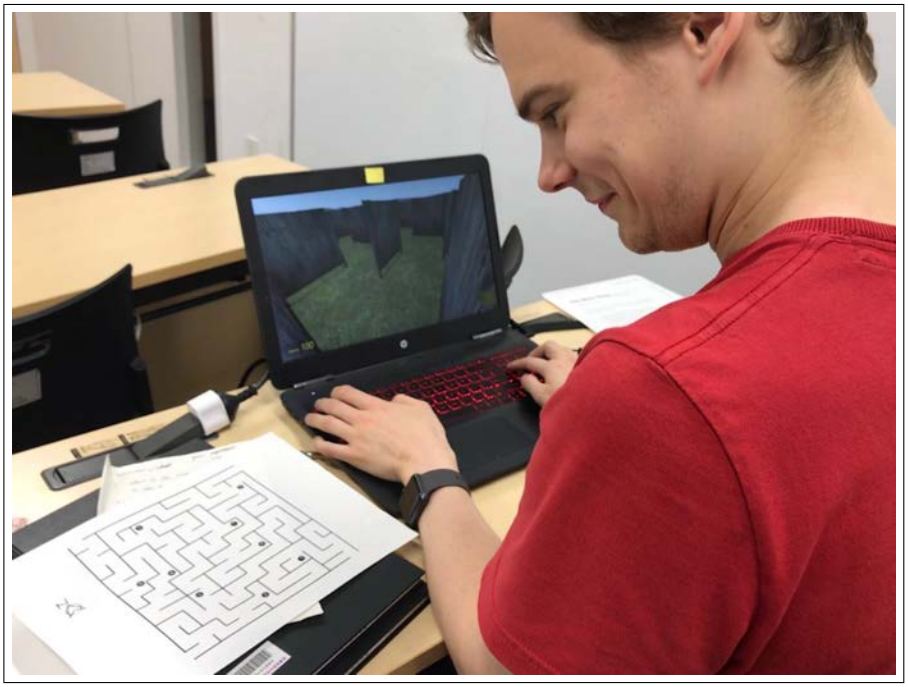

Figure 4.6: Instructor player checking the map

Figure 4.7: Operator player walking his avatar in the maze

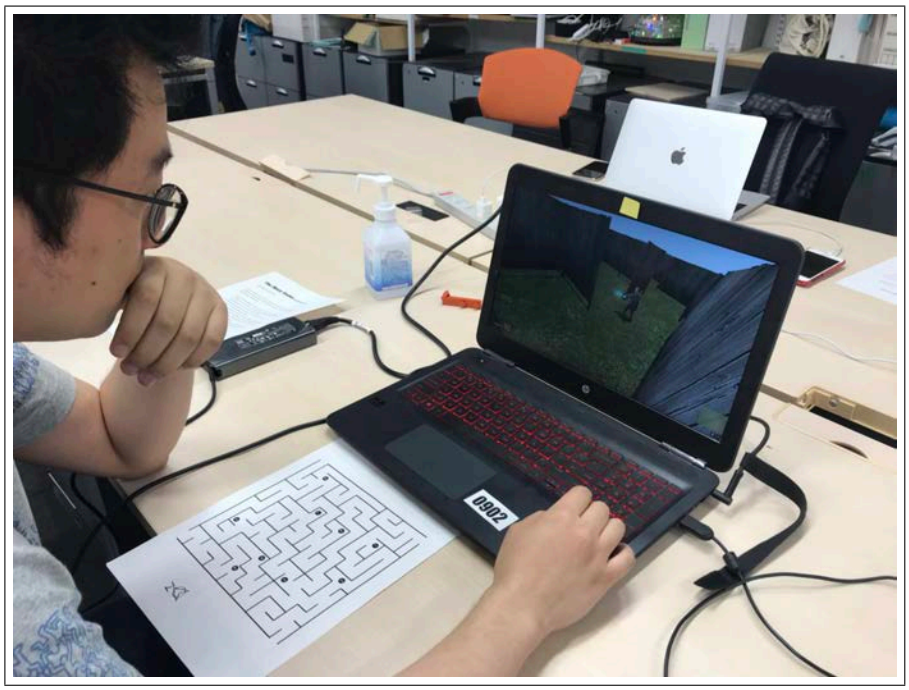

Figure 4.8: Instructor considering communication strategy

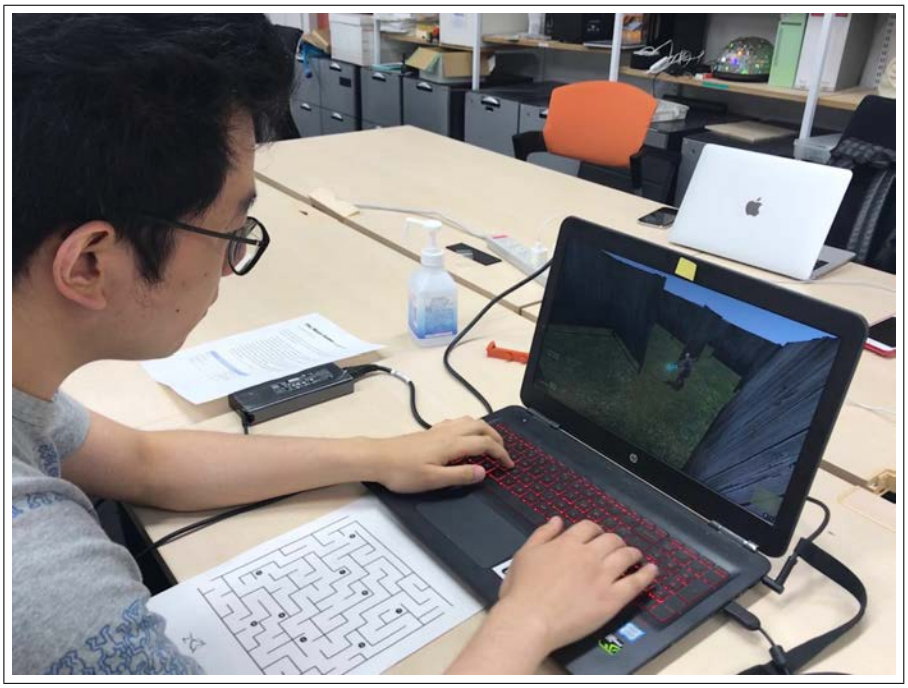

Figure 4.9: Instructor communicating with the Operator player

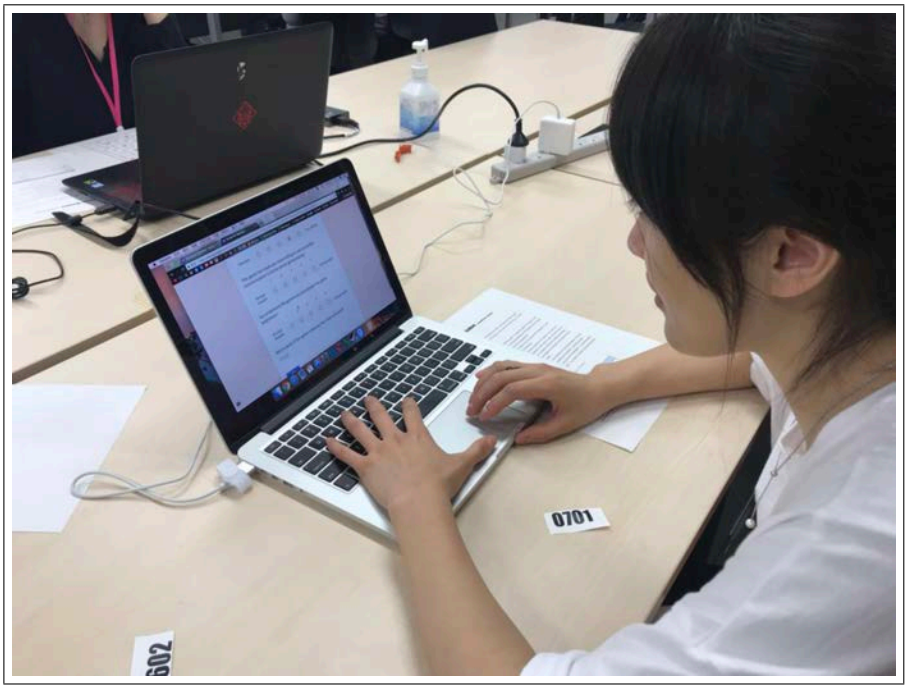

Figure 4.10: Player given a participant number to fill out questionnaire

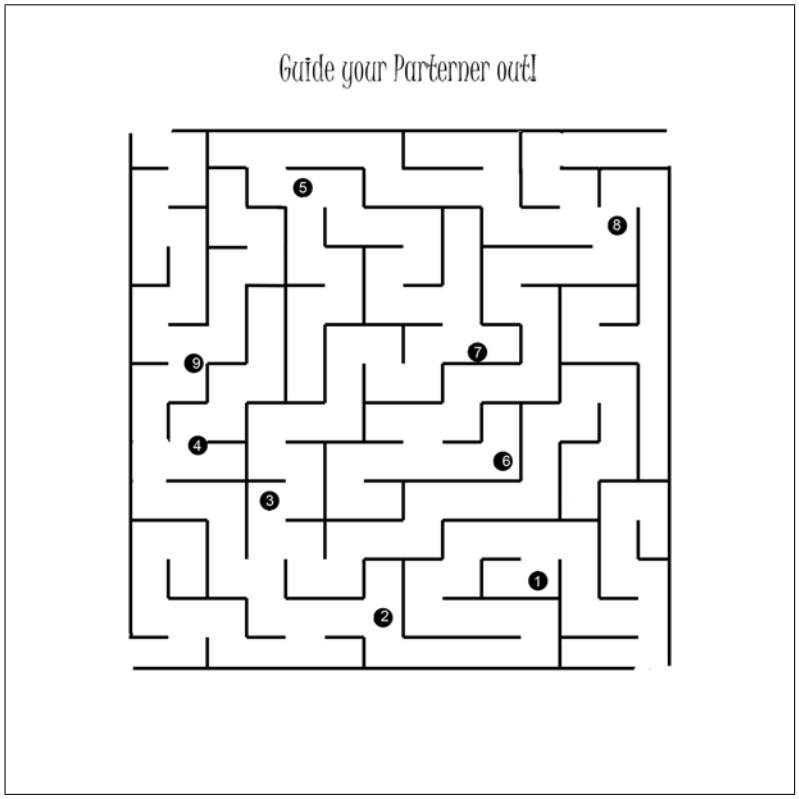

Figure 4.11: Maze map for the Instructor player

means as a game it has reached its target on making the players enjoyed. Not only the result of questionnaire showed that, but also can be observed that people talked about the joy of the game. It could be observed that many participants showed their passion in the game because they would not stop playing the game even if the time limit is reached. Also, people were talking about the "gesture" part of the game. One participant was talking to her partner player that she liked when the other player was doing the pointing forward gesture. It can be concluded that this form of game play does give people with joyful experience as a game needs to be.

Apart from the joyfulness of the game, the data of helpfulness relatively trends positive as well. Combining the helpfulness result data from both of the groups, it can be seen that people think the non-verbal communication in the game has played a vital role for navigating. This finding suggests that non-verbal communication as an independent communication method did provide vital communication function, meanwhile increased the accuracy of communication between the players, from the players point of view. The rest of the data collected from the questionnaire shows relatively positive on proving the hypothesis of positive game experience.The positive results of last three questions about game play demonstrated the attractiveness of the non-verbal communication based game design. However the result of the first two questions for the Operators may indicate that the functionality of non-verbal communication needs to be improved, at least enrich the selections of non-verbal communication actions.

However, as it can be noticed in the average value chart for both roles, there is slight mismatch between the two roles, especially in "communication helpfulness", "understandability" and "improvement on understanding of NVC". This finding reflects potential imbalanced game play experience for different roles. It can be interpreted in the graph that the result shows better game experience for the operator: there is lower game difficulty and slightly higher joy level. The reason for this maybe the different communication method for each role. In general, the graph has suggested that Non-Verbal Communication has higher understandability and communication helpfulness than textual message that is used by the Instructor. It possibly led to lower game difficulty for the Operator player. It, on the one hand, proves that Non-Verbal Communication can provide better game

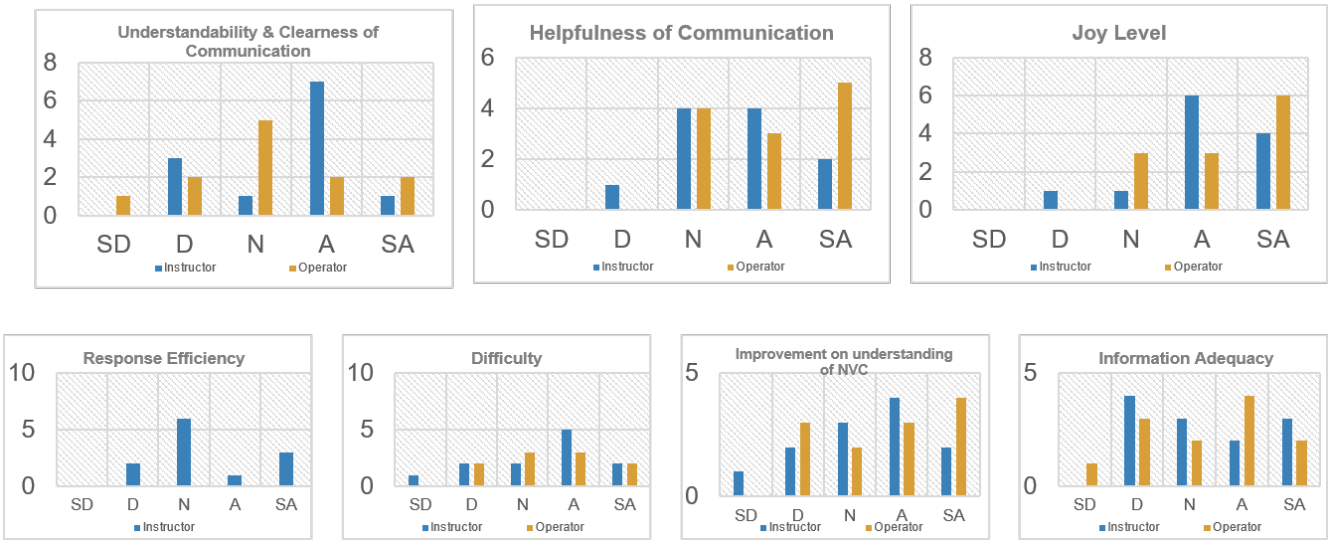

Figure 4.12: Qualitative survey results

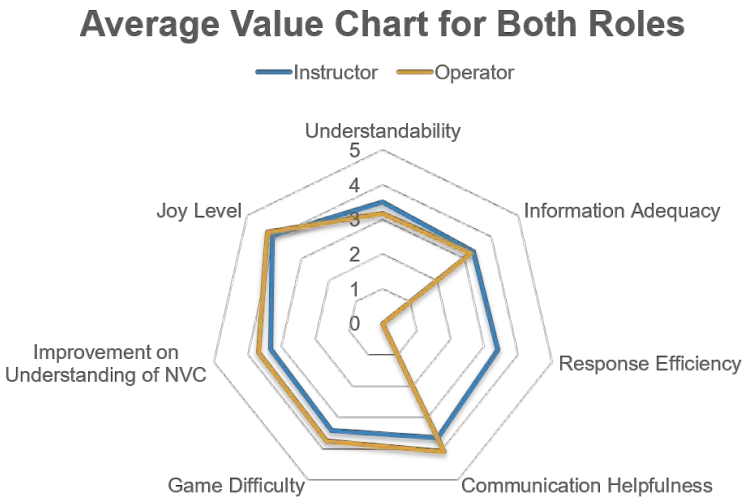

Figure 4.13: Average Value for Both Roles

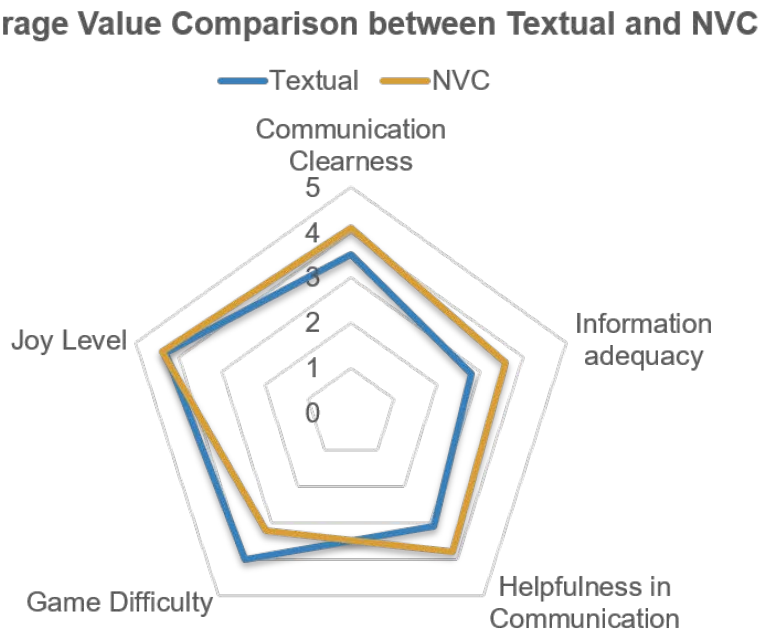

Figure 4.14: Average Value for each communication method

experience, but on the other hand reflects the imbalanced game design, which needs to be fixed in the future work.

In terms of the quantitative results, the chart of game finish rate does prove that Non-Verbal Communication is more efficient and helpful in assisting the players with faster passing the maze. With quantitative data found in the video clips analysis, non-verbal communication has provided with more accurate communication by allowing a direct confirmation to reduce the possibility of mistake.

Chapter 5

Conclusion

5.1. Summary

This project is about the design of a non-verbal communication based puzzle-solving cooperative online game. The game asks two players to concurrently play the game together so as to finish the task and reach the goal collaboratively.The two players each plays as a certain role who has its own unique ability. By following the mechanism and game design challenges, the game design shows its uniqueness in cooperative game play, as well as non-verbal communication features.The evaluation of the project has proved the non-verbal communication feasibility by conducting user testing with 22 participants involved. The result of the evaluation is derived by letting the participants play the game for two rounds with different communication method and fill out survey questionnaire to retrieve subjective and qualitative data, and video recording the game play to get quantitative data by analyzing the communication process.

The result of evaluation shows significance of non-verbal communication effectiveness in increasing the accuracy of communication in spatial information, as well as the efficiency in supporting the game play. In the majority of the game play, the most used gesture in the game was the "pointing forward" gesture, which can be concluded that the positioning gesture in a virtual environment could help players with better understanding in directional instruction. It gives the players a more direct demonstration on the direction, allowing players to have more accurate and better efficient communication. This sort of communication also can

potentially be a solution for international gaming communication, where players do not speak the same language but forced to make interactions. Moreover, the result showed the players are satisfied with the joyfulness that this non-verbal communication based game brings. It indicates that the form of Non-Verbal Communication in cooperative online game can be another source of joyful experience apart from the game itself.

5.2. Limitation

This design of the game and its evaluation still has its limitation due to technical reason and other reasons. The game is developed based on "Garry's Mod", which only support limited amount of game objects and level design. There were a few concepts or ideas for the design of the game but was never capable of implementing because of the limitation of the platform. Also because of the limited amount of non-verbal communication actions, this project is not able to test the other possibilities of non-verbal communication actions and genres. It would be much more realistic and could have more significant data if other non-verbal communication actions are supported for the game. Another key factor for understanding the Non-Verbal Communication, which was not taken into consideration during the experiments was that different culture background could lead to different understanding of Non-Verbal Communication. For instance, nodding in many regions in the world has the meaning of agree, but it can mean disagree in specific regions in the rest of the world. Without a mutual standard for Non-Verbal Communication in online games, fluent and flawless communication cannot be achieved.

5.3. Future Work

The game can be further modified in terms of non-verbal communication actions. Current non-verbal communication actions mainly focus on the spatial information such as gestures and navigating. As it is discussed in the non-verbal communication genres, there are more types of non-verbal communication can be adopted into this game such as haptic and facial expressions. Also the possibility

of adapting non-verbal communication for the Instructor player can be further investigated. Moreover, with the increased popularity on virtual reality, it is predictable that non-verbal communication in virtual environment is going to get more attention as an alternative communication method. It is very likely that non-verbal communication will be tightly connected with embodiment technology for virtual reality, so that the non-verbal communication actions will get more accurate and realistic. To increase the actual value and practical of this game, other advanced technology can be applied so that this game can be extended into other field of study such as education or training. Even though "Sign Language" is not considered as one of non-verbal communication, but they have the same characteristic in their performance and usage. This game would fit perfectly for "Sign Language" education after making revisions for its contents. Also it can be used in child education for children in their early ages to establish their sense of communication with others.

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Appendix

Figure 5.1: User manual for Operator

The Maze Game (unofficial name)

User Manual (Operator)

Thank you for playing The Maze Game (shortened as TMG), we hope you have a great experience while playing. Before you play the game, there are a few tips that you should realize to help you understanding.

1. TMG is an online collaborative adventure game. To play the game, two players with two different PCs are necessary. It is recommended that two players play the game in two separate spaces so as to have the full experience.
2. As TMG is a collaborative adventure game, the two players are designed to have different tasks and possess different information.
3. Your character in the game is set to be the Operator in the game. Your task is to control your avatar which spawns randomly in the maze to walk out of the maze at the correct exit. During the game, your co-player will text the related information using the in-game texting. You need to follow his instruction and respond to him using in-game nonverbal communication.
4. As operator, you need to respond to the instruction of your fellow player. The only way of doing it is using in-game nonverbal communication. There are several gestures of NVC, which includes but not only “GO FORWARD”, “GO BACKWARD”, ”WAVING”, “AGREE” and “DISAGREE”. You need to choose appropriate gesture action in front of the cameras.
5. The limited time to finish the game is 5 minutes.

List of actions	Key or mouse
Moving	WSAD
Look around	Mouse
Nonverbal Communication ring	Q
Shortcut of “GO FORWARD”	=
Shortcut of “GO BACKWARD”	-

Figure 5.2: User manual for Instructor

The Maze Game (unofficial name)

User Manual (Instructor)

Thank you for playing The Maze Game (shortened as TMG), we hope you have a great experience while playing. Before you play the game, there are a few tips that you should realize to help you understanding.

1. TMG is an online collaborative adventure game. To play the game, two players with two different PCs are necessary. It is recommended that two players play the game in two separate spaces so as to have the full experience.
2. As TMG is a collaborative adventure game, the two players are designed to have different tasks and possess different information.
3. Your character in the game is set to be the instructor in the game. You are given a paper which has the whole maze map printed on it. Along with the map, all 9 camera positions in the maze are revealed in the map too. Apart from that, you are also given access to all the 9 cameras view while playing.
4. Your task is to guide your co-player walk out of the maze at the instructed exit (there are 4 exits in every corner of the maze). You are only allowed to text the other player using in-game texting.
5. The limited time to finish the game is 5 minutes.

List of actions	Key or mouse
Moving	WSAD
Look around	Mouse
Access to camera	numpad1 to numpad9
Texting	Y

modified preliminary user test

* Required

1. **Please fill out your name** *

2. **Were you the instructor or the conductor in the last round of the game** *
Mark only one oval.
- Instructor
- Conductor

3. **What is your relationship with your co-player?**
Mark only one oval.
- Couple
- Friend
- Acquaintance
- Stranger

4. **Did you clear the maze in the given time**
Mark only one oval.
- Yes
- No

5. **How much have you understood the Nonverbal communication messages in the game?**
Mark only one oval.

	1	2	3	4	5	
Almost none						Pretty much everything

6. **How often have you ever been using this form of communication in games before**
Mark only one oval.

	1	2	3	4	5	
Never						Always

7. **How well do you think you have commmunicated with the other player in the game**
Mark only one oval.

	1	2	3	4	5	
I'm shit	◯	◯	◯	◯	◯	Awesome!

8. **Did the Nonverbal Communciation ring provide the corresponding action that you need**
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Part of

9. **how good do you think this way of communication helped your gameplay?**
Mark only one oval.

	1	2	3	4	5	
This is useless	◯	◯	◯	◯	◯	Very helpful

10. **How much joy did you get from the game**
Mark only one oval.

	1	2	3	4	5	
None	◯	◯	◯	◯	◯	Very joyful experience, thank you Yuluan!

11. **Comparing with Verbal Communication, do you think this form of communication have provided you more immersion?**
Mark only one oval.

	1	2	3	4	5	
Not at all	◯	◯	◯	◯	◯	Much more immserive

12. **Do you feel your understanding of Nonverbal Communication is improved in the second round of the game?**
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Sort of

13. **What opinion would you like to add for the nonverbal communication scheme and the game?**

Survey for Operator

* Required

1. **Your Participant Number: ***

2. **Did you pass the maze in the given time ***
Mark only one oval.
- Yes
- No

3. **How many times have you played TMG? ***

4. **The instructor's text is clear enough for guiding ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

5. **The nonverbal communication actions provided enough information for you to convey ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

6. **Your nonverbal communication helped the instructor with more accurate guidence ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

7. **How difficult is it to find the right path accroding to the instructor ***
Mark only one oval.

	1	2	3	4	5	
Very easy						Very difficult

8. **This game has made you more willing to use nonverbal communication in future online game playing** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

9. **You understood the game's joy and enjoyed the game experience** *
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

10. **Which parts of the game made you the most confused?**

_____

_____

_____

_____

_____

Survey for instructor

Fill out this survey if you were instructor in The Maze Game

* Required

1. **What is your participant number? ***

2. **did you pass the maze in the given time ***
Mark only one oval.
- Yes
- No

3. **How many times have you played TMG? ***

4. **The Operator's nonverbal communication was easy to understand ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

5. **The operator's nonverbal communication has provided enough information ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

6. **The operator responded quickly to your guidence using nonverbal communication ***
Mark only one oval.

	1	2	3	4	5	
Strongly disagree						Strongly agree

7. **The operator's nonverbal communication improved your guidance accuracy ***
Mark only one oval.

	1	2	3	4	5	
Stronlgy disagree						Strongly agree

8. **How difficult was it to locate the operator**
Mark only one oval.

	1	2	3	4	5	
Very easy	◯	◯	◯	◯	◯	Very difficult

9. **This game improves your understanding of nonverbal communication in games**
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

10. **You understood the game's joyment and enjoyed the game experience**
Mark only one oval.

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

11. **Which parts of the game made you the most confused?**

_____

_____

_____

_____

_____