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Master's Thesis
Academic Year 2015

Mamekun:
Design of a Game for Smartwatch to Improve Sedentary Lifestyle

Graduate School of Media Design,
Keio University

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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

Hanhsiang Tsai

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Abstract of Master's Thesis of Academic Year 2015

Mamekun: Design of a Game for Smartwatch to Improve Sedentary Lifestyle

Category: Design

Summary

Sedentary lifestyle has been proven to be associated with several health risks by researchers. Anup Kanodia, a physician and researcher, has also said "Sitting is the new smoking"[1], which warned people to not ignore the harm of prolonged sitting. This research aims to help people to get rid of sedentary lifestyle by proposing a game *Mamekun* to break sedentary time and engage people to conduct physical activity.

Mamekun is a game designed and implemented for the smartwatch with an exclusive gameplay which applies physical activity into an attractive pervasive game experience. The gameplay can be started through the notification which is used to remind a player that he or she is sitting too long. This thesis describes the concept and the design progress of *Mamekun*, and also aims to present an approach to providing new gaming experience on the smartwatch.

Keywords:

Sedentary Lifestyle, Behavior Change, Game Design, Pervasive Game, Wearable Device, Smartwatch

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1 *Don't just sit there. Really.* `http://articles.latimes.com/2013/may/25/health/la-he-dont-sit-20130525`

Table of Contents

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Sedentary Lifestyle

This research aims to create a game called *Mamekun*. Mamekun helps people getting rid of sedentary lifestyle by transforming physical activity into an attractive game experience which provides a repeatable and joyful digital pet gameplay on the wearable device.

People are becoming more and more inactive recently, especially for young people. According to the report of Ministry of Health, Labour and Welfare of Japan, the proposition of people who have a habit of doing exercise is about 30%, and no matter male or female, the lowest proposition appears in the people around the age of 30, only 13%. Besides, in the same report, it is also said that the proposition of people who remain inactive more than 10 hours a day is over 20%.[1] There are several reasons lead to this fact. The rapid development of technology changes the way we work, machines and personal computers have reduced many manual works and physical activities. Also, long working hours makes people have less time to exercise or do some leisure activities. Besides the work time, the way people use to entertain is also changed. Watching movies, listening to music or chatting with the friend, almost everything can be done through the internet or by the smartphone.

There is a word "Sedentary Lifestyle" which describes a type of lifestyle which people living with behaviors require low energy expenditure such as working in front of the computer, watching TV, and car driving, and have no regular physical activity.[2] Researches have pointed out that there are several health risks such as obesity, type 2 diabetes, cardiovascular disease and various cancers are associated with sedentary lifestyle.[3] Besides physical health issues, there are also researches

that proved sedentary lifestyle could also cause mental health issues. For example, people living in a sedentary lifestyle tend to be more anxious.[4]

In the report *Global Recommendations on Physical Activity for Health*[5] published by WHO (World Health Organization), it is also said that physical inactivity has been identified as the fourth leading risk factor for global mortality. Since sedentary lifestyle have been connected to several negative concerns, it is important to discover solutions in order to discourage it.

Exercise, may be considered as a useful solution. Certainly, doing exercise such as walking, jogging, and cycling have many benefits for health. They could control weight and build moderate body style, reduce the risk of several diseases and improve the mental health and mood. There are also numerous products in the market that engage people to start and make a habit of doing exercise. Take jogging as an example, Nike provides a series of products including shoes which designed to hold sensor and smartphone application which provide user a way to manage their own jogging history data.[6] Also, by taking advantages of these advanced products, many people did have made the habit of doing exercise few times a week. However, this does not mean that people who have a habit of doing exercise are not sedentary because the point of "sedentary" is judged by how long people take sedentary behaviors. If a person goes for a jog everyday morning but sits for almost the remaining time in the waking hour, it can still be considered as sedentary. Furthermore, because of the fact that physical activities and sedentary behaviors have different kinds of influence on human body, the benefits accumulated by doing physical activities could be reduced if a person spends almost of remaining hours doing sedentary behaviors.[7]

Therefore, it is believed that to actually discourage sedentary lifestyle, compared with doing "long-term exercise", having several times of "short-term physical activity" in a day to break out the sedentary time is much more effective. If people are willing to take regular physical activity during a day, they will become less sedentary. However, it is difficult to change people's daily behavior without providing motivation that is strong enough, developing such a habit could also be challenging. This research aims to utilize a game to solve it.

1.2 Games as A Solution

People have played games for a very long time, the history of games could be traced to ancient times. One of the reasons that why people love to play games is because they can get positive emotions such as happiness, fulfillment and excitement during the process. Despite emotional effects, games are always designed to be motivational that people would like to play games again and again to try to achieve goals in the game such as getting more points, leveling up quickly, and ranking in front of other players. Because of the emotional and motivational elements of games, people are intent to play games voluntarily.

By utilizing the fact that people are interested in games, there is a genre of games called *Serious Game* which attempts to achieve various of purposes other than pure entertainment. Several areas such as education, defense and health care, could be considered as "serious purposes". For example, *Microsoft Flight Simulator* is a comprehensive aviation game that can also be used for training. In healthcare area, the serious game has been considered as an effective way for behavior change. Research[8] reviewed several serious games for different application area such as surgery, nursing, and first aid. We can understand the fact that games which used to change behavior have been developed for many years.

In order to be able to use games to change people's behavior, having a persuasive gameplay is important. Virtual pet game is considered as an effective way to change behavior.[9] By transforming the real-world pet care experience to the game, people will be willing to act behaviors that could lead their pets healthy. Just like the real pet, people feed virtual pets when they are hungry, play with virtual pets when they are boring. Without the care, virtual pet will become unhealthy or even die. In healthcare area, there are also many approaches used the virtual pet to engage people. For example, in the game *Fish 'n 'Steps*, pedometers are provided to each player to count their daily steps. The more step a player walk, the more fish he or she will get. If we can properly translate real-world human-pet interaction to design a virtual pet gameplay, the game will become attractive and persuasive.

Among several types of serious game, *Exergame*, a term composited of "Exercise" and "Game", is especially widely developed as an approach to apply video games to physical activities. It can be found in almost every type of video game

platforms. The famous arcade game *Dance Dance Revolution*[10] is one of the earliest successful examples in the history. For home video game consoles, games such as *Wii Fit*[11] and *Dance Central*[12] have showed many possibilities of exergame. Because of the popularization of smartphones, games that utilize sensors or the GPS module on smartphones to create immersive experience can also be found in the market. *Zombies, Run!*[13] is a successful example of applying exciting gameplay into the context of jogging. In this ubiquitous society, many ideas that can never be realized before have become possible now. How to take advantages of new technologies and apply them to game design, is a challenge for game designers.

This research aims to provide a game with virtual pet gameplay to encourage people to engage physical activity. The game will be designed to run on a wearable device in order to provide an immersive game experience and attempt to explore the interaction possibilities of wearable games.

1.3 Possibilities of Wearable Devices

The term *Wearable Devices* describes electronic computing devices which are integrated into clothing or accessories that can be worn by people.[14] Because of the advancement of mobile technologies, in recent years, several types of wearable devices such as the wristband, glasses, and wristwatch can be found in the market. In 2015, the rapid growth of wearable devices market is coming into focus. According to *White Paper Information and Communication in Japan*[15] of 2015, the worldwide market for wearable devices is 23.28 million units in 2014, but have been predicted that will increase to 104.8 million units in 2015, and will become 223.9 million units in 2017. We can clearly understand the fact that wearable devices are becoming more and more popular, and have been being adapted to people's daily life.

Among these wearable devices, wristwatch type, which is also called as "Smart Watch" are gathering much more attention than other devices. In 2014, Google announced it's first platform Android Wear for smartwatches, which encouraged hardware manufacturers to produced several models of the smartwatch and mobile application developers to create applications for the smartwatch. In 2015, Apple released it's smartwatch hardware Apple Watch[16] and platform watchOS[17], and

has acquired 68 percent of market share of smartwatch devices with 16.7 million shipments.[18] Apple also announced that there have been over 10,000 applications specifically built for Apple Watch. This year can be considered as the first year that smartwatches are starting being popular. It is also a great timing to think about how to provide a smartwatch application which is really useful for people because we've seen a lot of failed examples which try to move smartphone applications to smartwatch directly without considering the context of the user.

Interactions between people and smartwatch are different from interactions between people and smartphone. While using smartphone applications, we hold the phone by hand(s) and watch the screen for 4 to 8 inches. We can concentrate on the smartphone for few minutes without feeling tired. However, when using a smartwatch, we need to raise the wrist as high as we can read the contents on the small watch screen which is less than 2 inches and can hardly keep for more than 10 seconds. This difference causes that interactions are limited to be quick on the smartwatch. If we want to design a game for the smartwatch, it is important to keep the gameplay as short as possible. The game can notify the player only when it is necessary because the smartwatch is worn by the player almost anytime anywhere. Also, by utilizing the built-in sensors such as pedometer, accelerometer and heart rate sensor on the smartwatch, data collected from the user could be used as the inputs of the game interaction which control the progress of the game.

This research aims to choose the smartwatch as the platform of the game. By considering carefully about how people will interact with the game, a specific short-term gameplay is designed to be played several times in a day to break out the sedentary time.

1.4 Concept

The game called *Mamekun* is proposed in this research. *Mamekun* is a digital pet game designed to engage people to move regularly in their daily life. By providing repeatable joyful short-term gameplay which fits into the context of physical activity, cute game characters and various items which attract player to keep playing during the whole game experience, people will be willing to stand up and take a casual physical activity for a while regularly in a day, which will help

people to get rid of the sedentary lifestyle, and get better physical and mental health in the long term.

As a digital pet game, the main game interaction is happening between people and virtual pet. In order to transfer the real world human-pet interaction into the game, ethnography of observing how people play with their pet was conducted. *Mamekun* has several interaction experiences that are similar to the real world such as walking with the pet, playing toys with the pet, and even finding the pet who get lost.

Mamekun is also a game that developed and designed to run on the latest version of watchOS, an advanced OS for Apple Watch, which is the most popular wearable device and smartwatch ever. Innovative technologies that created new kind of interaction ways between people and smartwatch such as *Digital Crown*, *Force Touch* and *Haptic Engine* were implemented into the game to provide natural and joyful user experience. Built-in sensors such as pedometer and accelerometer were also used to collect player's activity data as the input part of the game interaction.

In order to fit the game into the real world experience much more to attract the player to play, a game world setting and a game character was created. The main character in the game is called Mamekun, a Japanese word which means "little bean" because the shape of his body is just like a little bean. Mamekun was a normal dog living in the real world, until one day he accidentally touched a bling-bling watch dropped on the road. He was sucked into the watch world and could never get back to the real world. In the deep and dark watch world, Mamekun is tended to get lost easily, the player always has to find him back.

The basic gameplay of Mamekun is a digital pet game can be played anytime which player interacts with the character on the watch such as caress him, giving food, and play toys with him. However, the key gameplay called *Finding Mamekun* plays the main role of the game, which needs player really move his or her body to play.

In the Finding Mamekun gameplay, the game senses the state of the player. If the player has been sitting for a long time, it will send a notification with an animated picture and few lines of words such as "Mamekun is getting lost, go find him back soon". The player can just touch the notification on the watch screen

and enter the game directly, then he or she will be asked to stand up and walk around to find Mamekun. During the player's walking, he or she may bump into some random scenes or find some random items. If the player finds an item, the game will notify he or she with a short sound and haptic feedback on the wrist. The player can raise the wrist and touch "pick up" button on the watch screen to collect the item.

If the player bumps into a scene, he or she will also be notified, the watch screen will show a scene picture and few words which describe the scene, then the player needs to firmly touch the watch screen to open the menu, then choose an option to continue the game. The Finding Mamekun gameplay will end when the player finds Mamekun, which is designed to be able to be played in about 1-2 minutes. During the gameplay, the player will have to leave the seat and walk around, which achieve the goal of engaging people to move. After the gameplay, items picked up during the game can be used to interact with Mamekun, which plays the role of reward system of the game.

By continuously playing Mamekun, which combined this two kinds of different gameplays, the player will get accustomed to standing up and move for a while regularly in the daily life because the physical activity has been transformed into a joyful game experience.

Notes

1 平成25年「国民健康・栄養調査」の結果 `http://www.mhlw.go.jp/stf/houdou/0000067890.html`

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8 Ricciardi, F., and Paolis, L. T. D. (2014). A comprehensive review of serious games in health professions. International Journal of Computer Games Technology, 2014, 9. (Ricciardi and Paolis 2014)

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10 DDR GLOBAL GATEWAY http://www.konami.jp/bemani/ddr/jp/

11 Wii Fit, Nintendo http://wiifit.com

12 Dance Central（ダンス セントラル）- Xbox http://www.xbox.com/ja-JP/Marketplace/SplashPages/dancecentral

13 Zombies, Run! https://zombiesrungame.com

14 Wearable Technology and Wearable Devices: Everything You Need to Know http://www.wearabledevices.com/what-is-a-wearable-device/

15 情報通信白書平成27年版 http://www.soumu.go.jp/johotsusintokei/whitepaper/h27.html

16 Apple Watch http://www.apple.com/watch/

17 watchOS 2 http://www.apple.com/watchos-2/

18 Apple Watch is on Track to Capture 68 Percent of Smart Watch Market Share by the End of 2015 https://www.tractica.com/newsroom/press-releases/apple-watch-is-on-track-to-capture-68-percent-of-smart-watch-market-share-by-the-end-of-2015/

Chapter 2
Related Works

2.1 Approaches for Improving Sedentary Lifestyle

2.1.1 Overview of Approaches

There have been many prior researches that try to figure out the solutions to improve or discourage sedentary lifestyle. In this section, several different approaches will be discussed. To start with, Benjamin Gardnera[1] published a research aimed to review the existing papers and try to consider how to best reduce the sedentary behavior of adults by describing the behavior change strategies which are used in sedentary behavior reduction intervention evaluation. In the review, 26 studies with 38 interventions were summarized and analyzed. According to the result of the review, it showed that among the 26 studies, there were 23 studies that proposed "To increase physical activity" as their primary behavior change aim, while 8 studies used "To reduce sedentary behavior" as the primary behavior change aim. The result of intervention promise was also mentioned, the number of "Very promising" and "Non promising" are both 15, with 8 studies are "Quite promising". When deeply analyze the result of primary behavior change aims which were thought as more promising, 4 aims including education, persuasion, environmental restructuring, and training, were listed. Besides, when to analyze behavior change techniques observed among the studies, there were 11 techniques were found to be more promising: self-monitoring of behavior, problem solving, restructuring the social environment, providing information on health consequences, behavior substitution, unspecified social support, providing feedback on behavior, setting outcome goals, reviewing behavioral goals, using prompts or cues, and providing practical social support.

As the conclusion of the review, Gardnera pointed out that many researches were aimed to solve the problem of sedentary behavior by only increasing physical activity. However, the most promising ones were those aimed to reduce sedentary behaviors by using behavioral interventions. The review demonstrated the importance of treating "sedentary behavior" independent to "physical activity" because of the time spent in sedentary behavior has a correlate negative relationship with the time spent in the activity. Finally, it suggested designers to consider using environmental restructuring and self-regulatory techniques since they are more promising.

2.1.2 Increasing Physical Activity

From the review above, we can understand that the main ways to discourage sedentary behavior are increasing physical activity and reducing sedentary behavior. Cecilie Thøgersen-Ntoumani[2] proposed a study aimed to increase physical activity. The study implemented a sixteen-week lunchtime walking intervention which aims to enhance the work performance of the university employees who tend to lack physical activity. At first, 75 volunteers were chosen to attend the program and were randomize into two groups. One group of people have received intervention which provided them pedometers and motivational log-book and asks them to do 3 group-based lunchtime walks and 2-weekend walks during a week for 10 weeks. Both walks were limited to 30 minutes. After 10 weeks of the group-based walks, in the remaining 6 weeks, they were asked to do 5 independent 30-minute walks a week. Another group of people have received the same intervention but delayed for 10 weeks. Two groups of people were both measured after 16 weeks intervention.

This study proposed a comprehensive program to help people getting rid of sedentary lifestyle. By offering a lunchtime walking program, people who tried hard to achieve the goal of daily physical activity can easily participate and adopt the physically active lifestyle in the long-term. Also, the leaders of the walking group and the autonomy-supportive text messages both played the roles of motivating people.

2.1.3 Reducing Sedentary Behavior

Another paper published by Rhian E. Evans[3] focused on reducing the sedentary time during work time. At first, 30 healthy working adults who worked at a university in the United Kingdom, were recruited to participate the program. They were randomized into two groups, both groups received an education session about the health effects of sitting for long periods. While only a group of people are prompted to install a software on their PC which can remind them to stand every 30 minutes, the window of the software can not be moved or minimized. Both groups of people were asked to wear a device, which is used to record the acceleration and classify whether a wearer is sitting or standing, for 5 workdays. The sitting time of the both groups is recorded and measured. When the program started, the baseline number are nearly the same.

The result of the study showed that although for the total sitting time, there was no significant difference between two groups. However, for the prolonged sitting events, the number and duration were significantly different between two groups. The number and the time spent sitting in long than 30 minutes were both reduced in the group of people with software installed. From the study, we can understand that sedentary time can be broken by simply reminding people. However, the long-term effect is not evaluated yet that we can not conclude the intervention will also work in long-term.

This research aims to learn from the prior approaches and explore a way which can break and reduce the sedentary time while also encourage the physical activity at the same time. In this research, a game which applies casual physical activity into a pervasive game experience is proposed. In the next section, prior approaches about pervasive game will be discussed.

2.2 Pervasive Game Experience

2.2.1 Design Principles of Pervasive Games

Vlasios Kasapakis[4] wrote a paper which aimed to review the approaches of pervasive games recent years. In the study, the surveyed games were classified into three successive generations mainly by the transition of the technologies. The three generations of pervasive games are delimited between 2002 to 2009, 2009-2014, 2014-now. The first generation of pervasive games mostly used GPS to get the location of the player, and mostly used external sensors to incorporate the context of the player or environment into the game. Also, the player equipment usually included more than one device such as PDAs and feature phones. In the second generation of pervasive games, smartphones are used as the only player equipment, and the built-in sensors of smartphones are frequently used to record the context of the player or environment. The landscape of the third generation of pervasive games are still being developed but some possible features such as using wearable devices as player equipment or capture context by 3rd party web-services were suggested. When discussed these surveyed games, four design aspects are used to examine: Communication, Player equipment and game space visualization, Information model, Localization and context-awareness, and Orchestration. Under the examination of these aspects, the failed design examples were described as having the following features: relying exclusively on Wi-Fi, relying on high accuracy GPS fixes, using heavy HMDs, showing explicit map updates to visualize the position of the player, and requiring the player to hold the device for a long time.

The research also advised some threats which should be kept in mind when designing a pervasive game: safety, awkwardness, privacy, and team establishment. Finally, the research proposed the roadmap of the third generation pervasive games. First, wearable computing was mentioned as the trend. Although in the first generation of pervasive games, wearable computers were used, however, the use in the third generation of pervasive games are different from it as wearables are used as a means to provide interaction and generate immersive game experiences.

2.2.2 Pervasive Game for Promoting Eco Issue

Pervasive game as a means to educate or advertise people in order to change the behavior of people were also widely discussed. Evangelos Tolias[5] proposed a pervasive game called *IdleWars* which aimed to solve the problem of energy wastage by reducing the idle time of computers (the time a computer is not used but left on) in the workspace. IdleWars was a pervasive game which can be played on smartphones and desktop computers. In the game, the behaviors of saving or wasting energy of the player were recorded and reflected in the game score. When the game detect there is no movement of mouse or keystrokes for more than 5 minutes, it considers the computer as idle and shows a screensaver with a QR code on it. Any other players in the workspace can then use a smartphone to scan the QR code and follow the instruction to "bust" the computer. After the computer is busted, the screensaver showed on the screen will change to the profile photo of the player who busted the computer until the owner of the computer unlock it. The total number and the time of busted computer, the player who busted the computer, and the owner of the computer were collected and ranked, then be displayed on a public screen in the workspace.

After the evaluation with 20 employees participated during 10 working days, they were enthusiastically engaged in the game and reported to had fun with it that even extended the rules of the game. Also, the discussion about power management of the computer was triggered which proved that pervasive games can be used as effective way to raise the attention to issues and to promote behavior change.

2.2.3 Smart-objected Based Pervasive Game

Bin Guo[6] created a pervasive treasure-hunting game called *Treasure* which can be played in the context of people's daily life. Comparing with prior "design-before-play" pervasive games, the game proposed in the research aimed to make use of the "design-in-play" concept to enhance the variability of the game. By utilizing the smart objects, the game enabled the players to change the role, the action settings and the environment setting during they are playing the game. The game contained two stages: the game authoring stage and the gameplay stage. In

the game authoring stage, a group of game authors were allowed to configure the setting of the game such as deciding which role (target role or supporting role) an object is, defining when an object is found, what action (an image, an audio clip, or a video clip) will occur, and where the objects are hidden. In the gameplay stage, a group of players plays the game configured by game authors before. The gameplay contained two modes that enable the game can be played whether the game author and the players are in the same place or not. The players start to find the objects around the game space after the game started. When an object is found, the player put it on a "Treasure-Evaluation Center" to know the identity of the object, then the action of the object will be occurred to hint the player. The game ends when two target objects are found, which symbolize the treasure box and the key.

The result of the evaluations of the game showed that people thought the smart-object based gameplay was innovative, and also the feature of letting people configure the setting of the game got positive feedback. In the final part of the research, the possibilities of future improvement were suggested such as using the power of user creation and social sharing and providing more attractive user interface.

The game *Mamekun* proposed in this research utilizes those elements of prior pervasive games such as context-aware or behavior change and aims to explore the possibility of implementing wearable device into the pervasive gameplay. The prior approaches of gaming on wearable devices will be discussed in the next section.

2.3 Game and Gamification on Wearable Device

2.3.1 Wearable Game for Health

James Clawson[7] created a wearable game called *Dancing in the Streets* which aimed to discourage childhood obesity. The gameplay of the game *Dancing in the Streets* is similar to the popular arcade game *Dance, Dance, Revolution*: the player follow the rhythm of a song and a random set of four arrows appears on the screen and try to step the proper arrow on a dance pad to meet the arrows on the screen. While in the game *Dancing in the Streets*, instead of using dance pad, two wireless 3-axis accelerometers were worn on the players' ankles to capture the moving of the player. Also, the screen was replaced by a mobile phone to display graphics of the game. When the game starts, the player was first asked to train the sensor to recognize the movements. After the system was successfully trained, the player can then choose a song and start the game.

After the evaluation with 50 participants from high school, although there were little problems occurred by sensors, the game received nearly all positive response. Some students felt difficult at first but felt fun and challenging after the game, and were interested in challenging more difficult levels of the game. Also, almost all participants agreed they will enjoy playing the game with others at the same time, which showed that social element is a potential way to encourage people.

2.3.2 Gamification Approach on Wearable Device

Joi[8] presented a set of wearable wrist device and mobile application called *WearLove* which aimed to enhance affective communication between people. The prototype of WearLove wristband was built of a Arduino which included a Bluetooth module to connect to the smartphone, a capacitive sensor to capture touching from the user, and a 8x8 LED dot matrix to display shapes. By touching the capacitive sensor on the wristband, a user can send a heart to his or her partner, and the heart sent by the user will be displayed by the LEDs on the partner's wristband. In order to encourage users to express their love more frequently, WearLove application was created. In the WearLove application, a heart can be filled by sending the hearts through the wristband everyday as the daily goal. According to the

accomplishment of the daily goal, a flower will be given to user as the daily reward which can be collected, and a tree will be grown. The tree will continuously grow if daily goal were accomplished everyday, finally, a full grown tree will be grown as the monthly reward. The result of the evaluation showed that all of the participants felt the affective communication between them and their partners were enhanced. Also, the gamificaiton elements were thought motivative and enjoyable.

2.3.3 Social Game on Wearable Device

Misha Sra[9] designed a outdoor physical mobile team-based game called *Spellbound* which aimed to nurture the spirit of togetherness. The game took advantage of integrating real-world actions with a virtual world, and used voice interaction to replace touch-based input, also provide glanceable while haptic feedback experience by using wearable devices including one wristband and two armbands. The game contained three quest to be completed by two teams with total 6 people. The first quest "Find Quest" required players to find the location of the virtual item hidden in the game area by using their smartphone as "sonar device". When the player speak to the microphone, the smartphone will respond with "getting warmer/colder" with a haptic feedback on the armband of the right or left hand to indicate the location of the virtual item. The quest ends when the item is found and three times of spin are detected. The second quest "Save Quest" required players to jump three times in a specific area which can also be found by using the way in the Find Quest. The third quest "Recruit Quest" required players to ask a passer-by to speak to the microphone to complete the quest.

The result of the evaluation showed that all participants felt fun during the game, and agreed it was enjoyable to interact with the virtual world with physical jumping and spinning gestures. The wearable devices (armbands and wristbands) also received positive feedbacks. Some players said that they relied on them heavily to complete the quests, and the comprehensive feedback including visual, haptic and auditory was extremely useful. Also, they felt strong connect between members of the team through devices.

Different from only using wearable devices as the controller or the input part of the game, the game *Mamekun* proposed in this research aims to utilize the latest smartwatch technology and platform to provide a comprehensive game experience.

The player will be able to play the game on watch along without relying other calculating device such as smartphone or personal computer.

2.4 Contribution of This Research

Differ from only trying to engage people to conduct physical activity or only reducing the sedentary time/behavior of people, this research proposes a casual virtual game with extended gameplay to break the sedentary time and engage people to conduct physical activity at the same time. Elements of pervasive games are used to design the gameplay, but instead of only trying to persuade or motivate people through the game, *Mamekun* first provides a attractive pure game experience, and then affect the player through passive pervasive gameplay. Wearable devices implemented in the game of this research are not only used as the controller of the game, but used to provide comprehensive visual, haptic and auditory feedback. Also, the game *Mamekun* can be played without relying other handhold devices to provide more immersive game experience. The design and the implementation process to realize the game will be introduced in the next chapter.

Notes

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2 Thøgersen-Ntoumani, Cecilie and Loughren, Elizabeth A and Duda, Joan L and Fox, Kenneth R and Kinnafick, Florence-Emilie. 2010. *"Step by Step". A feasibility study of a lunchtime walking intervention designed to increase walking, improve mental well-being and work performance in sedentary employees: Rationale and study design.* BMC public health 10.1 (2010): 1-9. (Thøgersen-Ntoumani et al. 2010)

3 Evans, Rhian E and Fawole, Henrietta O and Sheriff, Stephanie A and Dall, Philippa M and Grant, P Margaret and Ryan, Cormac G. 2012. *Point-of-choice prompts to reduce sitting time at work: a randomized trial.* American journal of preventive medicine 43.3 (2012): 293-297. (Evans et al. 2012)

4 Kasapakis, Vlasios and Gavalas, Damianos. 2015. *Pervasive gaming: Status, trends and design principles.* Journal of Network and Computer Applications 55 (2015): 213-236. (Kasapakis and Gavalas 2015)

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6 Guo, Bin and Fujimura, Ryota and Zhang, Daqing and Imai, Michita. 2012. *Design-in-play: improving the variability of indoor pervasive games.* Multimedia Tools and Applications 59.1 (2012): 259-277. (Guo et al. 2012)

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8 Joi, Yeong Rae and Jeong, Beom Taek and Kim, Jin Hwang and Park, Ki Hyuk and Lee, Taehyun and Cho, Jun Dong. 2015. *WearLove: Affective Communication via Wearable Device with Gamification.* Proceedings of the 2015 Annual Symposium on Computer-Human Interaction in Play. ACM, 2015. (Joi et al. 2015)

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Chapter 3
Design

The goal of this research is to create a game to break the sedentary time and encourage people to conduct regular physical activity in order to get rid of sedentary lifestyle. To achieve this goal, a persuasive gameplay needs to be developed. While *Mamekun* can be played as a digital pet game anytime anywhere, too, the basic gameplay of the digital pet is also developed. In this chapter, the concept of the game *Mamekun* will be explained first, then the whole design process starting from ethnography research, ideation, to game design, implementation will be introduced and summarized.

3.1 Concept

The design concept of *Mamekun* is a digital pet game specifically built for the smartwatch, which has a basic gameplay *Playing with Mamekun* to provide entertainment element and an *Extended Gameplay*[1] *Finding Mamekun* to encourage the player to conduct regular physical activity while playing the game.

In the basic gameplay *Playing with Mamekun*, a virtual pet called Mamekun is cultivated by the player. The player can simply raise the wrist to watch Mamekun living in the watch and touch the watch screen to play with Mamekun using "items" the player owns. Items include several varieties of food, toys, accessories and other goods which can only be collected by playing the extended gameplay *Finding Mamekun*. In the extended gameplay *Finding Mamekun*, the player is asked to stand up and leave the seat several times in a day, then he or she have to walk around to find Mamekun until founded. During the walk, the pedometer sensor of the watch will sense how many steps the player has walked, then notify

the player with different subtle haptic vibrations and sounds when he or she find an item, bump into a scene and find Mamekun. The information of items and scenes will be showed on the watch screen after the player is notified.

Through playing the extended gameplay *Finding Mamekun*, physical activity is conducted regularly by the player. Also, items collected during the extended gameplay can be used in the basic gameplay *Playing with Mamekun*, which will encourage the player to continuously play the game. In the long term, a good habit of doing physical activity will be established, the sedentary time of a day can be broke out that the sedentary lifestyle will be discouraged, finally, both the physical and mental health of the player will be improved.

3.2 Ethnography Research

As the first step of the design process, the ethnography research method is used in order to understand how people act in their daily life. 2 times of fieldwork are conducted, the results will be analyzed and summarized later in this section. In the last, a target personal will be created as the possible player of the game, and will be used to ideate the concept of the game in the next section.

3.2.1 Fieldwork 1

The first fieldwork was conducted on 11th April 2015 at Tamagawadai Park[2] for about 1.5 hours at afternoon. Tamagawadai Park is a park just beside the Tamagawa River with a huge area of grass that people can walk their pets or do exercise there. The focus point of the fieldwork was to observe how people interact with their pets. During the 1.5 hours, 3 groups of people with their pets are asked to be observed and interviewed as fieldwork masters. Figure 3.2 shows the physical model of the fieldwork 1, which is the physical environment that 3 groups of people and their pets were observed. Other model analyzed from observations and interviews will be showed separately.

Figure 3.1: The Fieldwork Master and Their Pets of Fieldwork 1

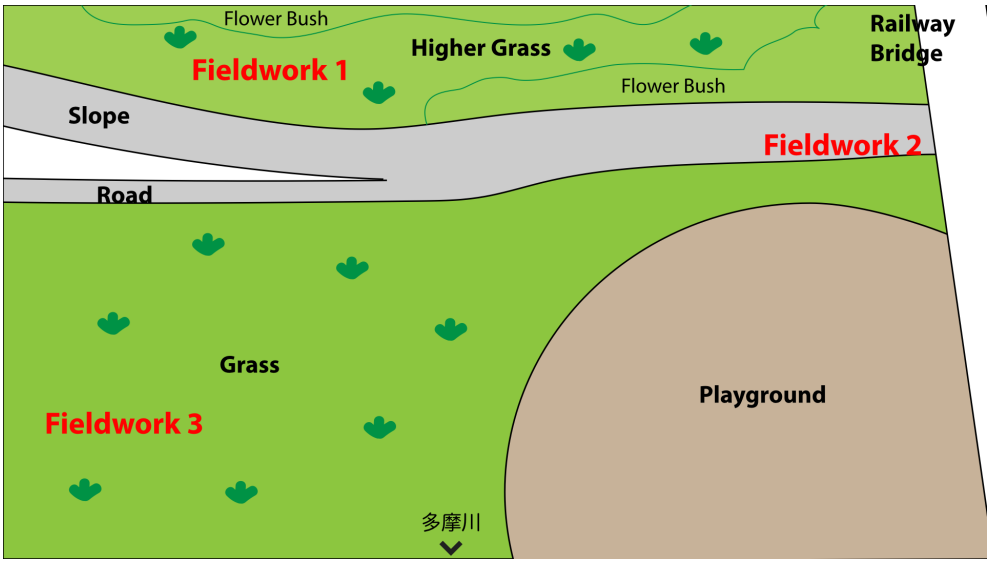


Figure 3.2: Physical Model of Fieldwork 1

Group 1

The first group was a married couple with their pet rabbit "Alexia". This was the first time that they took her out for a walk. Both of them like animals and have raised pets such as dogs, cats, and birds when they were young. They chose to raise a rabbit because they are now living in the city without enough space for other pets. They have no children and regard Alexia as their children. When at the home, there's an area limited for Alexia to walk around. Alexia is fed at the regular time or she will suffer from illness, which also makes their life pace become regular. They talk to Alexia and made a ball of natural fibers for her to play. When walked on the grass, Alexia was on a leash to prevent her from running away and lost. Figure 3.3 shows the flow model of the first group. Items in Figure 3.4 are artifacts that they use to care Alexia.

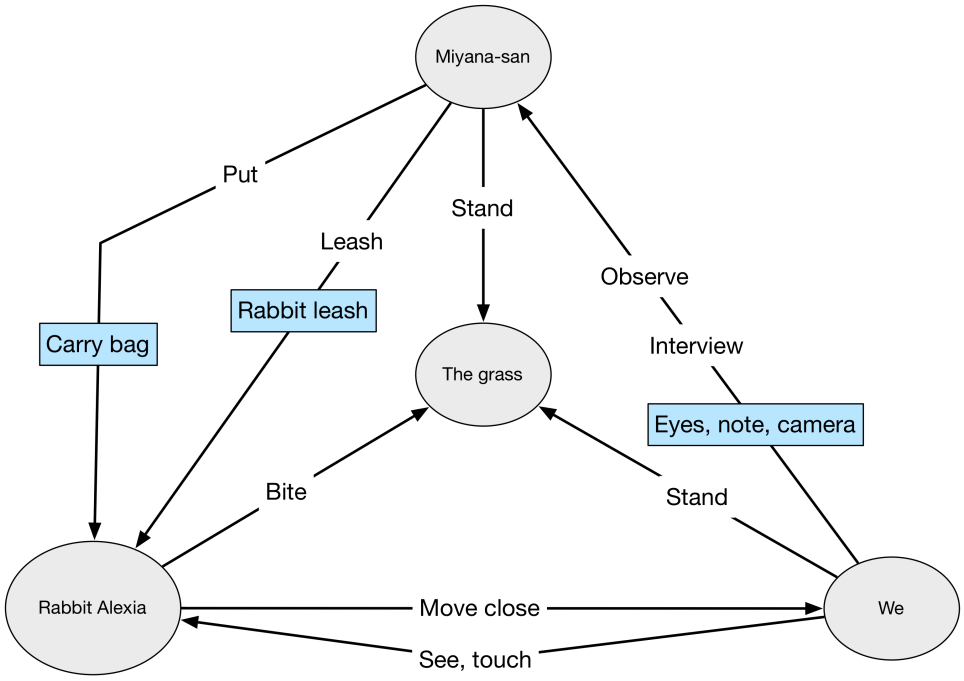


Figure 3.3: Flow Model of Group 1

Figure 3.4: Artifact Model of Group 1

Group 2

The second group was also a married couple, but with a dog "Noah". They rode two bicycles and let Noah running beside the bicycle. The husband has raised dogs before while the wife has no experience of raising any pets. The dog Noah was given by their friend and have been raised by them for about 2.5 years. They also have no children and regard Noah as their children, even sleep with him in the night. Like the couple in the first group, they also mentioned that since started living with Noah, their life pace has become regular. They need to feed Noah for 2 times a day and walk him every day. Sometimes they walk Noah with riding bicycles. They also talk to Noah and train him some skills like sit down. When at home, Noah plays with a ball and a toy bone. Figure 3.5 shows the flow model of the second group. Items in Figure 3.6 are artifacts that they use to care Noah.

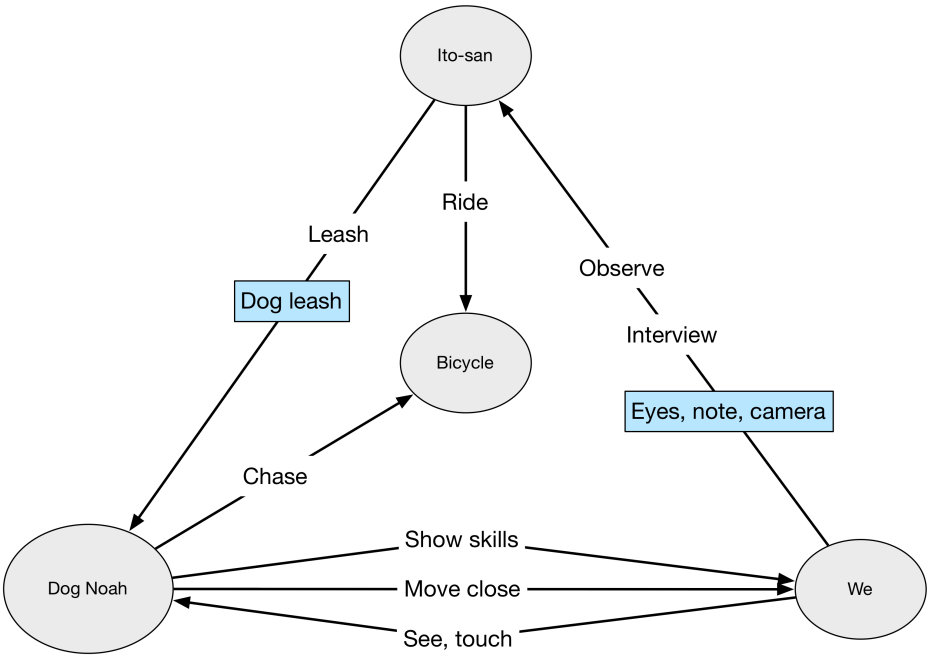


Figure 3.5: Flow Model of Group 2

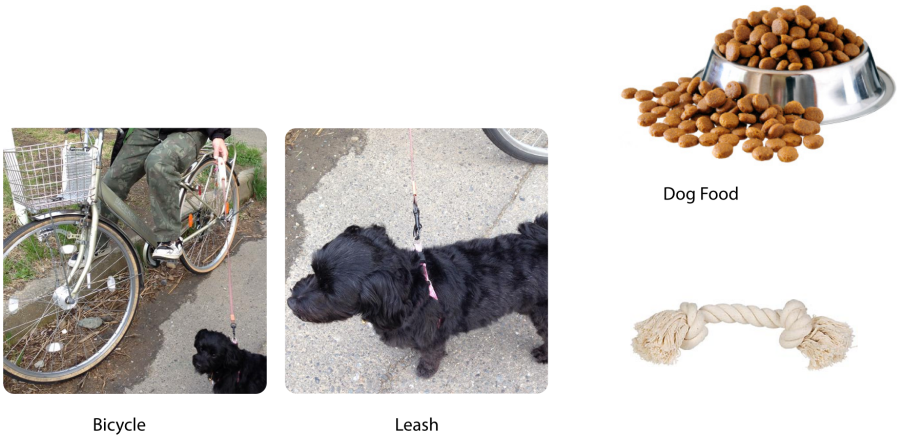


Figure 3.6: Artifact Model of Group 2

Group 3

The third group was a man who walked his dog “Chataro” along. Because his wife is busy with work, he is almost the one who take Chataro out for a walk. Every day at about 5:30 in the morning, he wakes up to feed Chataro, take him out for a walk and then go to the office. After he comes back from work, at about 6:30 in the afternoon, he will take Chataro out for the second walk. Chataro was a very active dog that never stop running during the time we observed. During the walk, he played a ball with Chataro by throwing the ball far away and let Chataro pick back. If Chataro does pick the ball back, he will get a piece of snack as the reward. During observing, there was another dog raised by a children living nearby who is also the classmate of his son. Chataro played with the dog very passionately. Figure 3.7 shows the flow model of the third group. Items in Figure 3.8 are artifacts that he use to care Chataro.

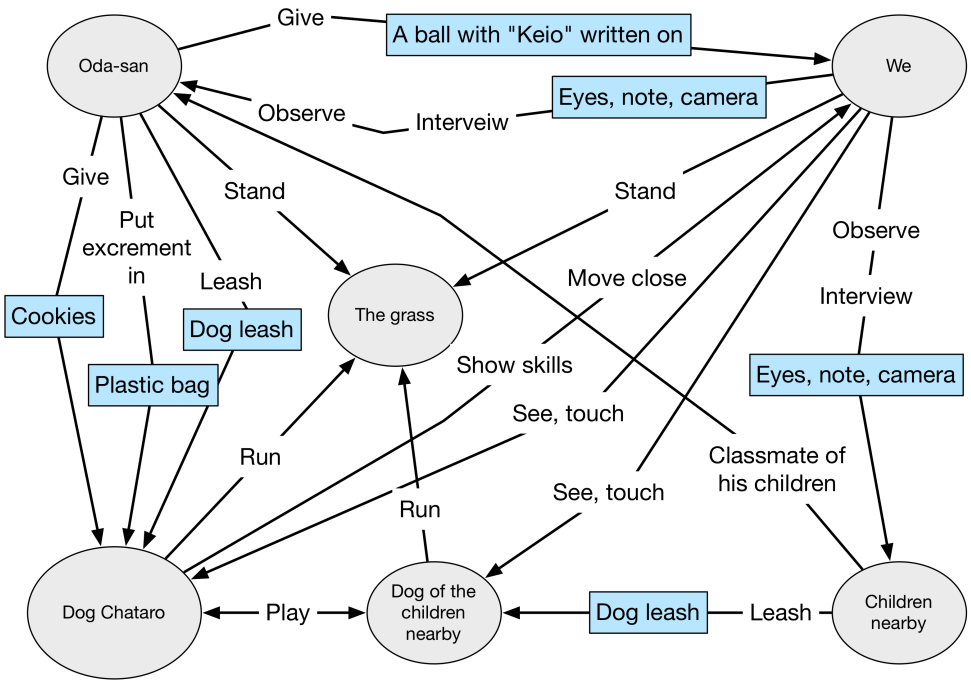


Figure 3.7: Flow Model of Group 3

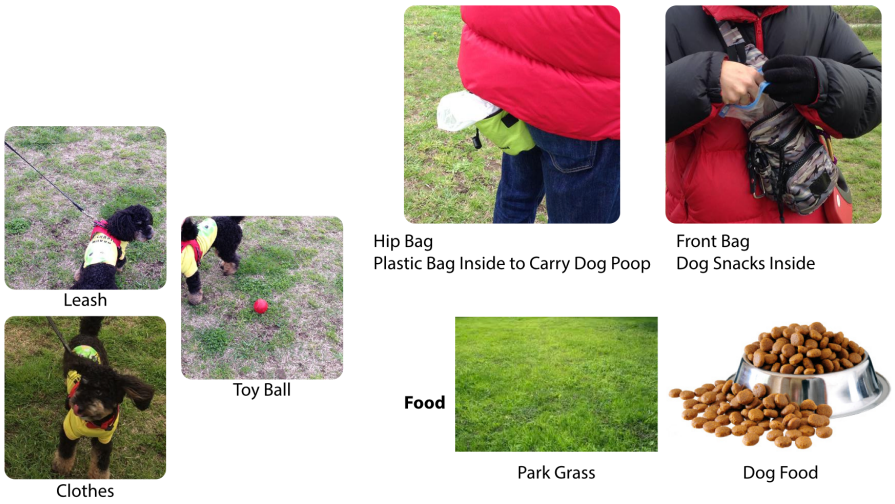


Figure 3.8: Artifact Model of Group 3

Mental Model

From the analysis of observation and interview during the fieldwork, actions made by fieldwork masters which were especially worth noticing were recorded. The first mental model which was extracted from these recorded actions was created. The second mental model (abstract mental model) was created based on the first one.

Cognition	Actions
Notice the wind is becoming strong	Take the rabbit back home
Feel tired	Talk to pets
Know it is regular time	Feed pets
See photos of the pet sent from her children	Send back her own photos of the pet back
See us play with the pet	Show skills of the pet
See the pet did the skill as spoke	Give the pet cookies
See other people with pets	Talk to them
See own pet fighting with other pets	Stop the pet and apologize

Table 3.1: Mental Model of Fieldwork 1

Cognition	Actions
Notice the danger	Avoid it
Feel tired	Try to relieve it
Feel the routine	Do regular things
See people	Show off
See the pet doing good	Reward it
See the pet doing bad	Stop it

Table 3.2: Abstract Mental Model of Fieldwork 1

3.2.2 Fieldwork 2

The second fieldwork was conducted on 7th June 2015 at Tsunashima Kaido from Hiyoshi Station to Musashikosugi Station for about an hour at night. The focus point of the fieldwork was to understand the mental model of the person who has a habit of jogging by observing how she act before, during and after the jogging. Once the mental model is extracted, it can be used to create a more persuasive game.

Figure 3.9 is the fieldwork master of the fieldwork. She was a 22-years-old university student with a habit of jogging 2-3 times a week. During her jogging, she was used to using Nike+ application on the smartphone to track her jogging, and listen to pop music she listens to at normal days. She always started the jogging from the sidewalk in front of Hiyoshi station and run towards the north. Until the application remind her it has been 2 km, she will stop running forward and turn back, therefore, the distance of her jogging can be controlled in about 4 km every time. Figure 3.10 shows the physical environment of her jogging.

Figure 3.9: The Fieldwork Master of Fieldwork 2

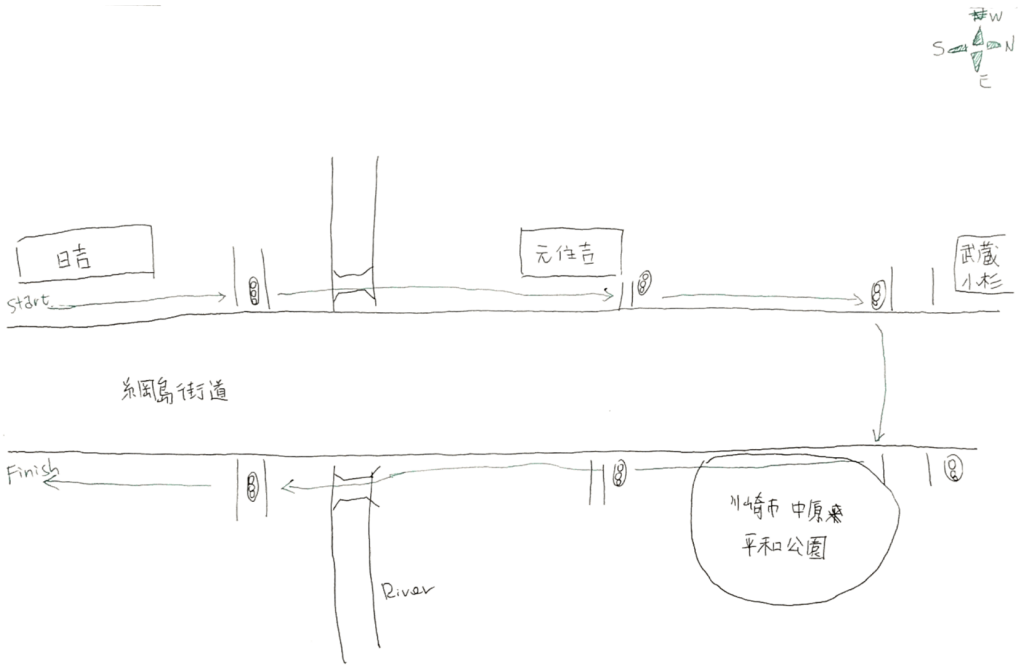


Figure 3.10: Physical Model of Fieldwork 2

The reason why she started jogging since 3 months before was because she wanted to go on a diet. In order to motivate herself, she invited her roommates to run with her and also made a promise that the person who runs the most in a week will not need to wash dishes. She recorded her own weight every morning after the shower because she said she weigh the most light at the time. If her weight decreases to under 48 kg, she will stop jogging. The time she always ran was about 5 to 6 o'clock afternoon or late night. She never ran during the daytime because was afraid of getting tanned. Also, she did not like to run during the winter days because of air is too cold to breathe.

Before the jogging, she warmed up for a little while to prevent injury. During the jogging, she wore the earphone which connected to her smartphone in the pocket. Although her running pose was not so proper, she was very concentrating on running at a steady pace, and only stopped when the traffic light turned red. When asked what she was thinking during the jogging, she said she think nothing but only listening to the music. When there were other people running before or beside her, she felt much more motivated and do not want to stop running.

After the jogging, she removed the earphone and checked the jogging data on her smartphone. Although she was soaked wet with sweat, she can not wipe it without bringing a towel. This is also the reason she did not want to take a selfie of herself although she sometimes take the picture of her shoes and upload to the Instagram. She also mentioned that if her speed becomes faster, she will want to post her jogging record on the Nike+ application. Finally, before she went back her home, she bought a liter of pineapple water to drink.

Figure 3.11 is the flow model which shows how she achieve her jogging. Figure 3.12 shows the items she used during her jogging. Figure 3.13 explains the relationship between her and her friends who were in the real life or on the internet.

Figure 3.11: Flow Model of Fieldwork 2

Figure 3.12: Artifact Model of Fieldwork 2

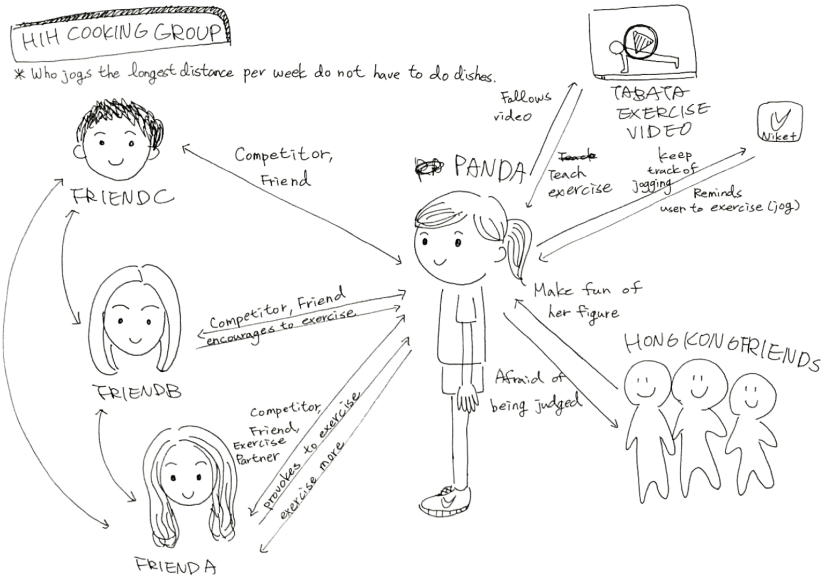


Figure 3.13: Cultural Model of Fieldwork 2

Mental Model

From the analysis of observation and interview during the fieldwork, actions made by fieldwork masters which were especially worth noticing were recorded. The first mental model which was extracted from these recorded actions was created. The second mental model (abstract mental model) was created based on the first one.

Cognition	Actions
See the notification of the app	Go jogging
Think about have to wash dishes	Go jogging
See the increase of her weight	Go jogging
Feel cold	Give up going jogging
Know it is time to jog	Tie her hair, change the clothes, listen to music, warm up, start the app
Hear the remind of app	Turn back
See the traffic light becomes red	Stop and wait for green light
See other people running beside her	Keep running and do not want to stop
Know the goal is finished	Confirm the data from the app and drink some water
Know the speed of jogging increased	Show off to friends on the SNS

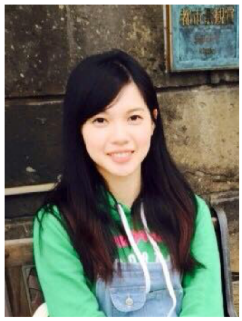
Table 3.3: Mental Model of Fieldwork 2

Cognition	Actions
Think about there will be bad things happen	Avoid it
Know about something is about to start	Prepare completely
See or here the instruct	Follow the instruct
Feel of other people 's eyes	Want to show the good side of self
Meet with an obstacle	Try hard to achieve it
Know about the goal is achieved	Feel relieved and take a break

Table 3.4: Abstract Mental Model of Fieldwork 2

3.2.3 Target Persona

Through analysis of fieldworks did above, a target persona who is considered as the player of the game is created as Figure 3.14. Nakamura Kyoko, a 24-years-old female office worker who works at an internet media company as an editor. Her main job is to discover fresh materials on the internet that female readers may interested in and write them as articles. Therefore, she tends to sit almost the whole day in front of the computer.



Nakamura Ryoko

Gender	Female
Age	24
City	Tokyo
Hometown	Shizuoka
Occupation	Editor

Personal Profile

Nakamura went to an university in Tokyo and entered the college of literature after graduated from senior high school at her downtown. She is very curious about various of things, especially interested in those are cute and funny. She mixes well with other people at school but also has own sense of judgement. Although she is a person with passive personality, once she start a thing, she will try hard to finish it. She loves pets, and has been raised a Shiba dog when she was in the elementary school.

Working Profile

She entered a internet media company at Shibuya as an editor after she graduated from the university. Her job is to collect materials that female readers may be interested in, and write into articles. She always feel fulfilled when getting positive feedbacks from her readers, this also motivates her to continue the job. Beside the job, she like to use SNS such as Twitter and Instagram to share her findings in the daily life to her friends. Because of her job, she almost sit in front of the PC in the whole day, she feels the health state is not as good as before, but can hardly find a solution to it.

Goals

To be able to relieve the stress
Want to discover new things
To become as healthy as before
Want to feel fullfilled after working hard

Figure 3.14: Target Persona

3.3 Ideation

In order to generate as many as ideas which can be used to develop concepts later, in the ideation stage, the brainstorming method was first conducted. Based on these ideas, several concepts are created and presented with paper sketches. Finally, to evaluate if the concepts can really provide values for the target persona, several rapid prototypes were made.

3.3.1 Brainstorming

To conduct the brainstorming method, 2 female graduate students were invited to help to generate different varieties of the idea. Before the brainstorming, the information of fieldwork results, mental models and the target persona were shared in order to make sure everyone can understand the aim of the brainstorming. Stickies and marker pens were distributed to everyone to draw or write ideas.

There were 3 minutes for each round of brainstorming. After each round finished, about 1 minute of the sharing time was conducted. Until about 100 ideas were generated, the brainstorming is finished. Figure 3.15 shows ideas generated during the brainstorming. Finally, ideas were grouped by their contents as Figure 3.16.

Figure 3.15: Brainstorming with Stickies

Figure 3.16: Brainstorming with Stickies (Grouped)

3.3.2 Concept Making

Based on ideas generated from the brainstorming stage, several different concepts of the game were created. At first, concepts were almost focused on a game that the player can exercise with the virtual pet, and the look of the virtual pet depends on the player's frequency of exercise. If a player is too lazy to do exercise, the pet will become fat as to reveal the inactivity of the player.

However, after evaluated concepts with the target persona with her goal, and considered about the value propositions that the game should provide, finally the concept of a lighter and shorter excluded gameplay with a basic virtual pet gameplay that can be played anytime, was developed. The idea of designing a game for a smartwatch was also adopted from this time, which also has an influence on the design of the game world and the gameplay.

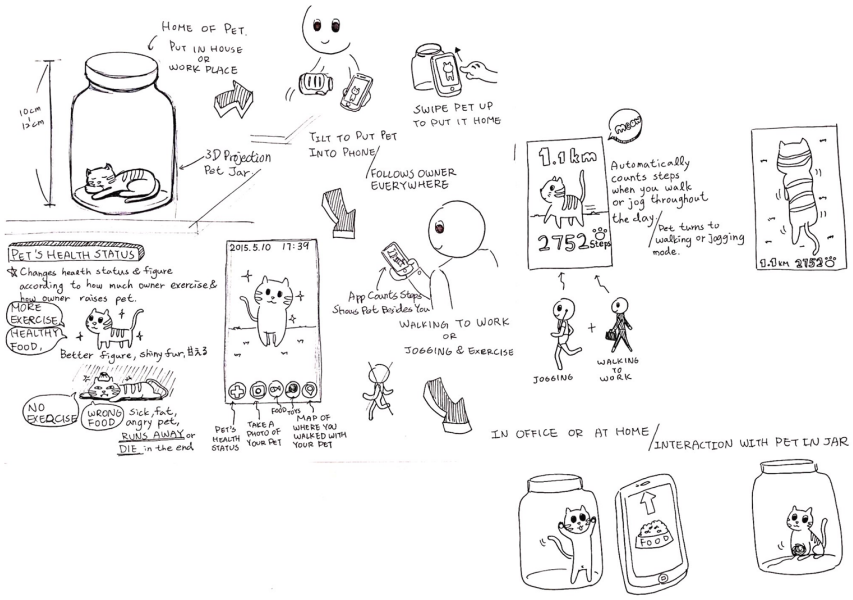


Figure 3.17: Concept Sketch 1

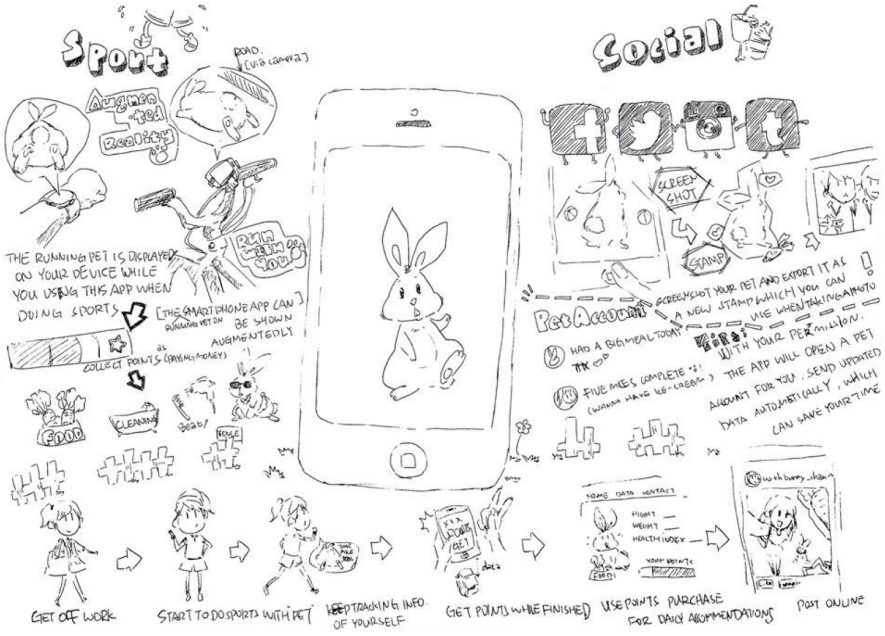


Figure 3.18: Concept Sketch 2

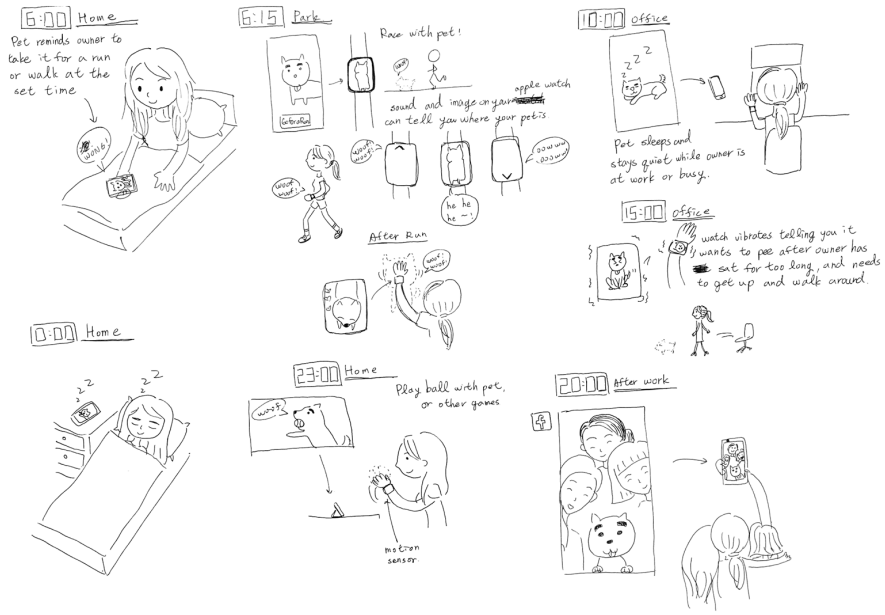


Figure 3.19: Concept Sketch 3

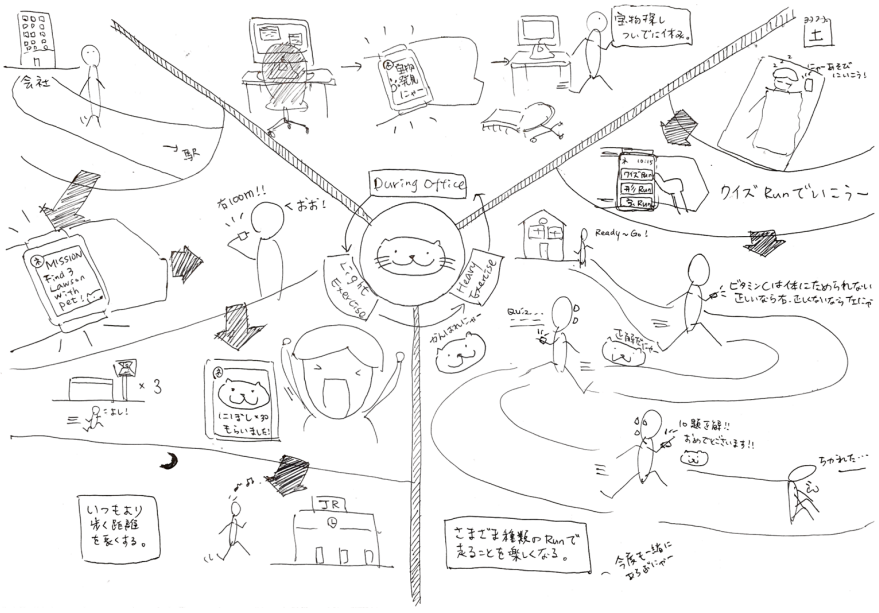


Figure 3.20: Concept Sketch 4

3.3.3 Prototyping

During the ideation stage, several rapid prototypes were created and used to evaluate the concepts. These rapid prototypes were made of existing materials, applications and devices rapidly that can be immediately experienced after the concepts were created. The first rapid prototype in Figure 3.21 was made to feel the experience of running with a pet appearances on the watch screen. From the prototype, the fact that it is not quite practical to see the watch screen while in the jogging was understood. The second prototype in Figure 3.22 was made to feel the experience of taking a selfie with the virtual pet, and the result showed that the feature was attractive especially for female players. The third prototype in Figure 3.23 was made to feel the experience of throwing a ball to a virtual pet. The interaction was quite joyful, but the game was limited to a place where a smartphone can be placed.

Figure 3.21: Rapid Prototype 1

Figure 3.22: Rapid Prototype 2

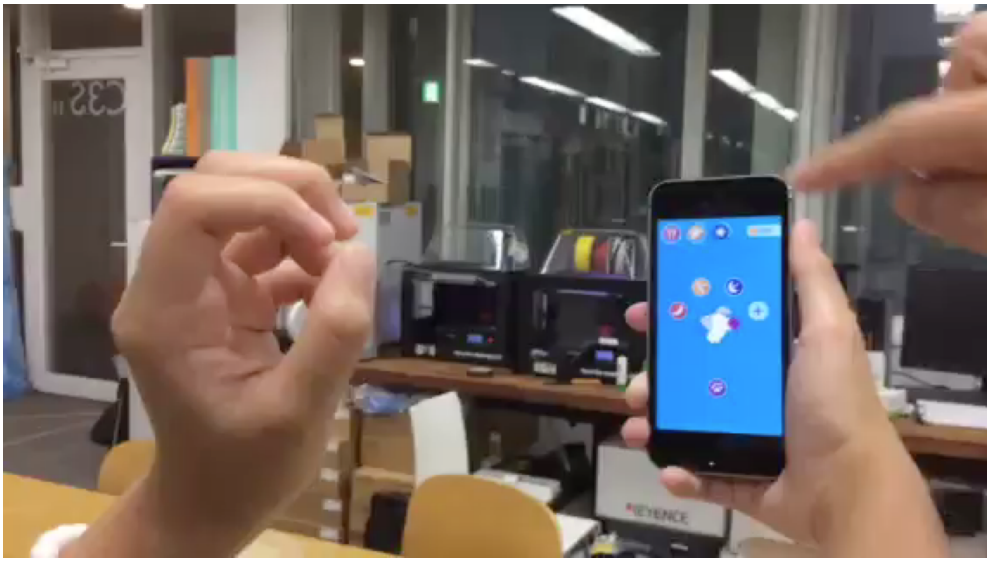


Figure 3.23: Rapid Prototype 3

3.4 Game Design

3.4.1 Character

The whole game design process started from designing a main character of the game. Since the gameplay of the game is basic a virtual pet game. An attractive pet character needs to be represented. At the first time of choosing what pet to use as the main character in the game, a variety of pets including dog, cat, chicken, and even alien animals were mentioned. Also, the idea of letting the player choose the pet he or she like to raise was also discussed. However, after considered the target persona and the main concept of the game is to encourage people to do physical activity, the dog though may seem a little normal, was chosen to be the main character of the game. To create a dog character that is attractive, the design directions was decided to exaggerate the appearance of the dog to let it looks even a little stupid. Figure 3.24 shows the idea sketch of the dog character. The nose and eyebrows of the dog were emphasized, and the body type was set to be mellow. Because of the shape of the character looks like a little bean, it was named as "Mamekun", which means "little bean" in Japanese.

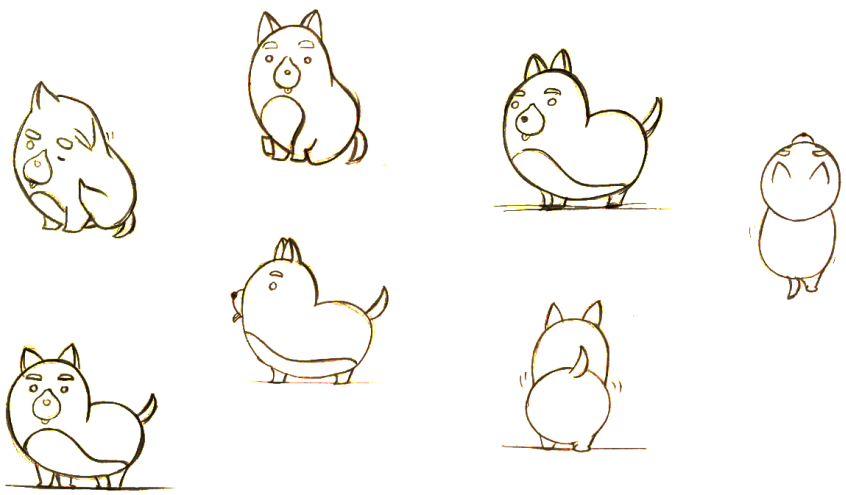


Figure 3.24: Idea Sketch of Game Character "Mamekun"

3.4.2 Game World

After the main character of the game was decided, the virtual game world where the character lives in also needed to be created. A well-designed game world will be persuasive for the player while they are asked to act in the real life. Since the game is specifically designed only for the smartwatch, the virtual space inside the watch was naturally chosen as the world of the game. To describe the relationship between the character Mamekun and the watch world reasonable, a story was written as below. Figure 3.25 shows the graphic version of the story.

Mamekun was a normal cute dog lived in a normal world, until the day he met the accident. One day afternoon, a good weather for a walk, he was walking around on the road just like he always did. He walked a while and accidentally found a bling-bling watch which was dropped on the road. He was very curious about the watch and tried to touch the watch. However, suddenly a blinding light came from the watch lightened the sky. Mamekun felt the strong wind blowing around, and at the next second, he was sucked into the watch. From then, he became the first dog that only lives in the watch, and never get back to the normal world. The world in the watch is extremely dark and huge just like a black hole of the universe, and the watch screen is the only medium connected with the real world. If no one notice Mamekun in the watch, he will vanish into the darkness of the watch world.

Figure 3.25: The Story of The Game World

3.4.3 Gameplay

To design the gameplay of *Mamekun*, several existing games, mobile application and smartwatch applications are referenced for inspiration.

Walkr[3] is a game on iOS to encourage people to walk more. The main characters of the game are an 11-year-old genius boy Collins and his pet Doggii. He invented a spaceship Walkr to explore the universe. The spaceship is powered by walking energy which can be produced by the player. With walking energy, the spaceship can leap through space to explore and collect new planets. By helping creatures living on the planets, the player can receive coins to build new "Dynamic Food Replicator" to generate food. The game also has achievement and mission features that can play with friends together.

Nekoatume[4] is a popular iOS game made by Japan and then became famous in the world. It is a simple while attractive cat cultivation game. The main screen of the game is a home with a garden which can place several items, and two space are particular for cat foods. When cat foods are placed for a while, cats are attracted and come to eat, and play with other items placed. They will leave "niboshi" (small boiled and dried fish) as the gift for the player and leave. Niboshi can be used as coins to buy items in the game. Also, the player can take a photo of the cute cat anytime and save to the album.

Toby[5] is a virtual pet game specifically built for Apple Watch but can also be played on the iPhone. The character of the game, Toby, is an active cute dog needs to eat, play and rest. By caring Toby, such as giving foods or play with him, the player can get coins to unlock more options such as different foods and items to play. Besides the main gameplay, there are also some little games can be played and earn coins.

Activity[6] is a default application on Apple Watch provided by Apple. The application measures all activities the user do in a day and divide them into three indicators: Move, Exercise and Stand. The progress of these indicators is displayed as three concentric circles with different colors. By fill all circles with colors, the daily goal is achieved. It will notify the user to remind to move more in order to clear the goal. Also, an achievement system is designed as when the user reaches the personal best or hit a milestone, a personalized badge will be given.

The gameplay of *Mamekun* are inspired from the games above, and after considered the character and the game world design mentioned before, several principles are developed as below:

- The main screen of the watch is the home of the character Mamekun
- Items in the game are used to play or care the character Mamekun
- Normal items are collected during a gameplay which can be played anytime
- A gameplay which can be played once upon a time to get special items
- Walking in the real world equals walking in the game world.

Under these principles, two different gameplays are designed: *Playing with Mamekun* and *Finding Mamekun*. They will be introduced in the following section with the descriptions of the goals, rules, and the feedback system, which are suggested as the defining traits by Jane McGonigal[7]

Playing with Mamekun

The basic gameplay of *Mamekun* is *Playing with Mamekun*. It is a virtual pet game which can be played anytime from the watch. The player can stroke the character Mamekun and see him react cutely or feed him and play with him with items.

- Goals
  - Caring the character Mamekun
- Rules
  - Consumptive items such as foods will be used up and need to recollect again
  - Other items such as toys and accessories can be used forever until the player throw them away
  - Only one item can be used at one time

  - Mamekun will get lost and need to find back if the player does not care him for a long time

- Feedback System
  - When to touch Mamekun on the watch screen, he will react to the player with animated pictures
  - A haptic touch with subtle sound to let the player know the item is successful used.

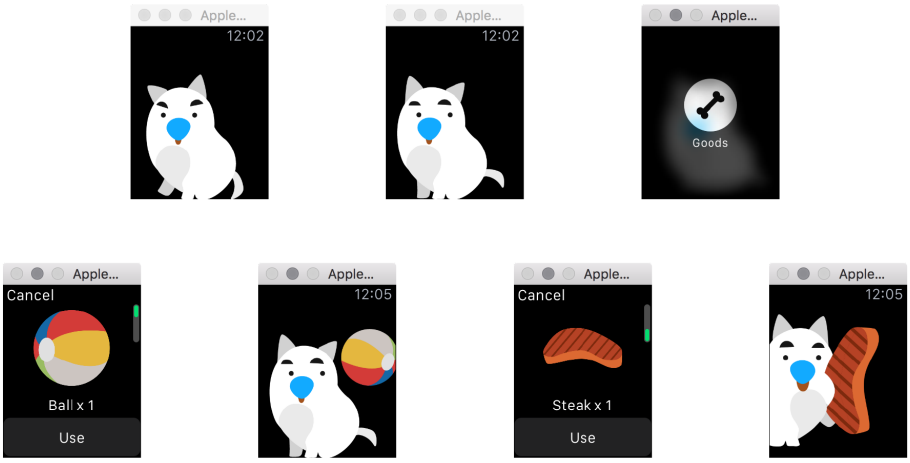


Figure 3.26: Gameplay *Playing with Mamekun*

Finding Mamekun

Finding Mamekun is the key gameplay of the game *Mamekun*. According to the game world settings, Mamekun is living in a world of the watch where is extreme dark and huge so he always get lost when going outside. The player has to find him back or the game will not be able to play without the character. This gameplay uses the mental model of when a pet is getting lost, the master will go find the pet back worryingly, to make the game much more persuasive.

- Goals
  - Finding lost Mamekun back
  - Collect items during the way to find Mamekun
- Rules
  - The game can only be started when getting the notification
  - If the notification is overlooked by the player, it can be started from the home screen of the game
  - During the game, the player have to walk until getting notification to the next scene
  - When an item is found, the player can choose to pick up or abandon it
  - If the player chooses to finish the game without finding back Mamekun, collected items will be abandoned and Mamekun will not appear in the home until the game are finished
- Feedback System
  - A notification will be sent to remind the player that Mamekun is getting lost and the player has to find him back
  - After the game start, the player has to walk as he or she is finding Mamekun in the real world
  - When an item is found or a scene is bumped, a haptic touch and subtle sound will be used to notify the player to stop walking and see the watch screen
  - When Mamekun is found, the game ends

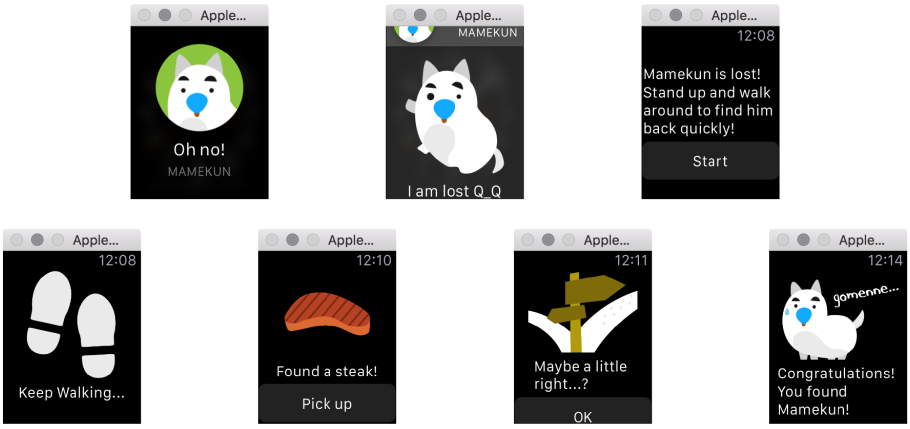


Figure 3.27: Gameplay *Finding Mamekun*

3.5 Implementation

3.5.1 Overview

The game *Mamekun* proposed in this research is specifically designed to run on a smartwatch device in order to provide immersive game experience. Although there are many smartwatch products can be found in the market nowadays, platforms of smartwatch are mainly led by two companies. The first one is Android Wear [8] released by Google, and the second one is watchOS[9] released by Apple. Both of the platforms provide rich application programming interfaces (APIs) and modern software development kit (SDK) with graphic user interface (GUI). Considering that Apple Watch running on watchOS are implemented with many advanced features such as *Digital Crown*, *Force Touch* and *Taptic Engine* which could provide more possibilities of interaction, the watchOS and iOS platform were chosen to design and develop the game.

The architecture of the watchOS application is showed in Figure 3.28[10]. The *Watch App* controls the user interface part on the watch, while the *WatchKit Extension* controls the logic part of the watchOS application. As described in the figure, in the latest version of watchOS, watchOS 2, allows the logic part (WatchKit Extension) of the watchOS application runs natively on the watch, which means it is possible to build a completely native application for the Apple Watch. The game *Mamekun* was built on the watchOS 2 by using WatchKit[11] API, which provides native supports such as Core Motion[12] and several interface objects[13].

In order to conduct the user test to evaluate the concept of the game proposed in this research, the necessary parts of the game: notification, pedometer data processing, and all the user interfaces of the game, were implemented for the prototype. These parts of the prototype complete the flow of the game that is enough to provide the core concept for players. Figure 3.29 shows the flow of the prototype. In this section, three main implemented parts of the game will be explained.

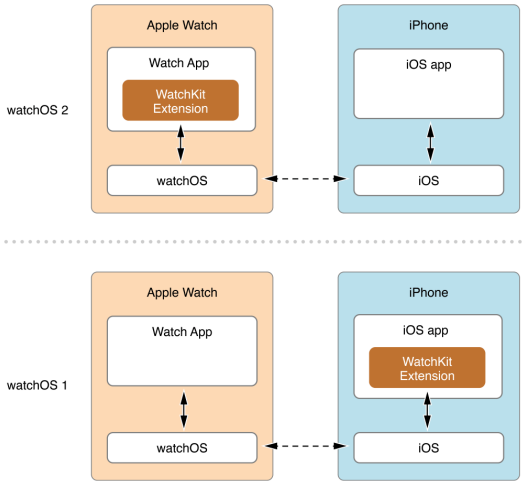


Figure 3.28: The Architecture of watchOS Application

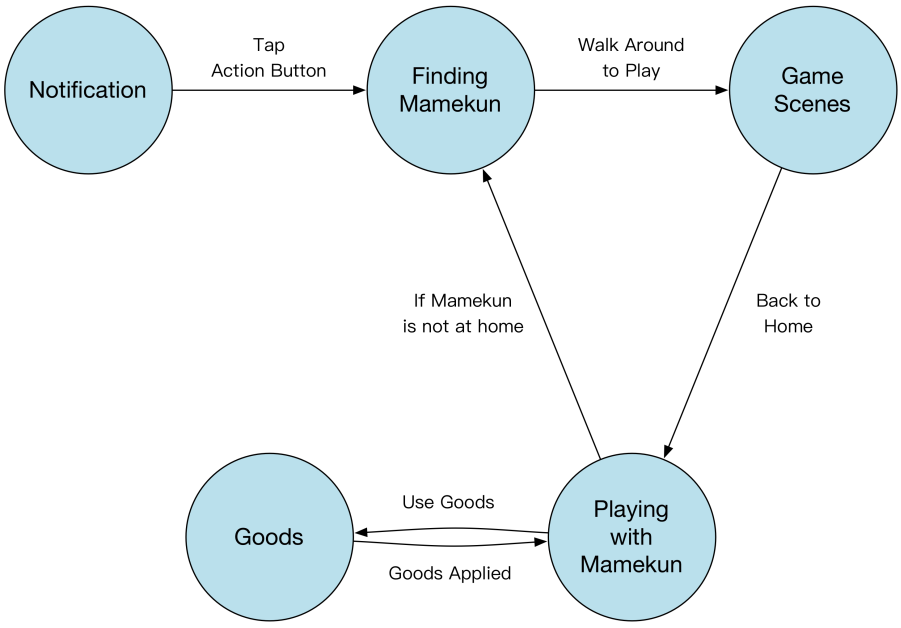


Figure 3.29: The Flow of The Prototype

3.5.2 Notification

In the gameplay Finding Mamekun, the game senses the player to understand the inactivity duration of the player. If a player is sitting too long, the game will send a notification to tell the player that Mamekun is lost, start the game to find him back quickly. To implement the notification function, a custom notification with texts and a picture is needed. In WatchKit Frameworks[14], the class WKUserNotificationInterfaceController[15], a class designed to custom user interface for a local or remote notification, is used to display the notification of the game.

In the prototype, it is designed as when a button object of the Mamekun iOS app is tapped, a notification will be sent and showed on the watch. Figure 3.30 shows the code written in the class ViewController on the iOS app. It describes when the button object is tapped, a custom notification will be sent, and the texts of title, description and action button of the notification are appointed.

To process the behavior after the notification is tapped by the player, a custom subclass of WKUserNotificationInterfaceController called *ActionNotificationController* is created. Figure 3.31 describes when the notification is tapped, the game will be opened and directly enter the gameplay Finding Mamekun.

```
- (IBAction)notifyButtonTapped:(id)sender {

    NSLog(@"sending notification!");
    [[UIApplication sharedApplication] cancelAllLocalNotifications];

    UILocalNotification *localNotif = [UILocalNotification new];

    localNotif.fireDate = [NSDate dateWithTimeIntervalSinceNow:5.];
    localNotif.timeZone = [NSTimeZone defaultTimeZone];

    localNotif.alertTitle = @"Oh no!";
    localNotif.alertBody = @"Mamekun is lost!!";
    localNotif.alertAction = NSLocalizedString(@"go", nil);

    localNotif.soundName = UILocalNotificationDefaultSoundName;
    localNotif.applicationIconBadgeNumber = 0;
    localNotif.category = @"save";

    [[UIApplication sharedApplication] scheduleLocalNotification:localNotif];
}
```

Figure 3.30: Custom Notification

```
- (void)didReceiveLocalNotification:(UILocalNotification *)localNotification withCompletion:
    (void (^)(WKUserNotificationInterfaceType))completionHandler {
    // This method is called when a local notification needs to be presented.
    // Implement it if you use a dynamic notification interface.
    // Populate your dynamic notification interface as quickly as possible.
    //
    // After populating your dynamic notification interface call the completion block.
    [WKInterfaceController reloadRootControllersWithNames:[NSArray
        arrayWithObjects:@"SceneController", nil] contexts:[NSArray
        arrayWithObjects:@"sceneLost",nil]];

    completionHandler(WKUserNotificationInterfaceTypeCustom);
}
```

Figure 3.31: Behavior After The Notification Is Tapped

3.5.3 Pedometer Data Processing

The built-in pedometer sensor on the Apple Watch is used to collect the steps the player walked. To implement the function, Core Motion Framework[16] is used. Also, the class CMPedometer[17] and CMPedometerData[18] are used to request and manage the pedometer data from the system.

In the prototype, when the gameplay Finding Mamekun starts, the system is told to start to record the step data, and transform the step data to an integer in order to do the processing later. For the meanwhile, a random integer variable between 10 to 30 is created to be compared to the step data. Then, if the number of steps a player walked is counted to be bigger than the random number, the game will randomly choose a scene from the array generated before and open it, then notify the user with a haptic touch and a subtle sound. Until every scene in the array is used, the ending of the gameplay (Mamekun is found) will be showed. Figure 3.32 shows the code of the description above.

```
- (void)willActivate {
    // This method is called when watch view controller is about to be visible to user
    [super willActivate];
    //calculate pedometerdata only when sceneWalking
    if ([self.currentContext isEqual: @"sceneWalking"]) {

        self.pedometer = [[CMPedometer alloc] init];

        if ([CMPedometer isPaceAvailable]) {

            int randomSteps = (int)10+arc4random()%30;
            NSLog(@"random steps= %d",randomSteps);

            [self.pedometer startPedometerUpdatesFromDate:[NSDate date] withHandler:^
                (CMPedometerData * _Nullable pedometerData, NSError * _Nullable error) {
                NSNumber *walkedStepsNum = pedometerData.numberOfSteps;
                [self.labelStepsNum setText:[NSString stringWithFormat:@"Walked Steps:%lu",
                    [walkedStepsNum unsignedLongValue]]];

                int walkedSteps = [walkedStepsNum intValue];
                NSLog(@"walked steps= %d",walkedSteps);

                //IF WALKED A WHILE, GO TO NEXT SCENE!
                if (walkedSteps > randomSteps) {

                    //random array and pick a scene to go
                    _index = arc4random_uniform(_mut.count);
                    _randomScene = (@"%@", _mut[_index]);                    Expression result unu
                    NSLog(@"index = %i",_index);
                    NSLog(@"randome scene = %@",_randomScene);

                    [_mut removeObjectAtIndex:_index];
                    if (_mut.count == 0) {
                        _mut = [_sceneArray mutableCopy];
                        NSLog(@"********************");
                        [WKInterfaceController reloadRootControllersWithNames:[NSArray
                            arrayWithObjects:@"SceneController", nil] contexts:[NSArray
                            arrayWithObjects:@"sceneFound",nil]];
                    }

                    [self presentControllerWithName:@"SceneController" context:self.
                        randomScene];
                    //                    [WKInterfaceController
                        reloadRootControllersWithNames:[NSArray
                        arrayWithObjects:@"SceneController", nil] contexts:[NSArray
                        arrayWithObjects:randomScene,nil]];
                }
            }
             ];
        }
    }
}
```

Figure 3.32: Pedometer Data Processing

3.5.4 User Interfaces

The main way to implement the user interface on Apple Watch is to use the class WKInterfaceController[19]. This class works like the class UIViewController[20] of iOS applications. Also, by referencing the class WKInterfaceObject[21], interface objects can be used to manipulate the visual elements displayed on Apple Watch.

In the prototype, three subclasses of WKInterfaceController are created to handle the interface of the game. The first interface controller is named as HomeController (Figure 3.33), it is used to control the interface of the gameplay Play With Mamekun, also the home of the character Mamekun. The only visible interface object in this controller is an animated picture of Mamekun. This picture will animate when it is touched by the player. Besides the visible one, there are three buttons hidden into the menu, which can be activated by firmly touching the watch screen. These buttons are links to other functions such as using the goods and entering the gameplay Finding Mamekun and Adventure with Mamekun.

The second interface controller is named as SceneController (Figure 3.34). It is used to control all of the scenes of the game. The interface objects displayed on the screen differ from the type of the scene. For example, if it is a scene to tell the player an item is found, there will be a picture of the item showed with the name of the item, and a button to continue the game. SceneController also handles the logic of the gameplay Finding Mamekun and Adventure with Mamekun using pedometer data explained above.

The third interface controller is named as GoodsController (Figure 3.35). It is used to control the items of the game. Picture of items is showed on the screen with the name of items. The player can navigate using the digital crown of the Apple Watch to choose the item to use. When an item is picked to use, this controller will send the name of the item to HomeController in oder to display the proper picture of Mamekun, and will give the player a feedback with haptic touch to tell the player an item is successfully used.

```
#import "HomeController.h"

@interface HomeController ()
@property (nonatomic, strong) NSString *currentContext;
@property (unsafe_unretained, nonatomic) IBOutlet WKInterfaceGroup *mameImage;

@end

@implementation HomeController

- (void)awakeWithContext:(id)context {
    [super awakeWithContext:context];
    // Configure interface objects here.

    //set Mamekun's picture to the right context
    self.currentContext = context;
    NSLog(@"Mamekun's context is %@", context);

    if (self.currentContext == NULL) {
        self.currentContext = @"Normal";
        [self.mameImage setBackgroundImageNamed:@"mameOnNormal"];
    }

    else {
        [self.mameImage setBackgroundImageNamed:[NSString stringWithFormat:@"mameOn%@", context]];
    }
}

- (void)willActivate {
    // This method is called when watch view controller is about to be visible to user
    [super willActivate];
}

- (void)didDeactivate {
    // This method is called when watch view controller is no longer visible
    [super didDeactivate];
}

////////////////////////////////// Every Menu Item Settings Below ////////////////////////

- (IBAction)goodsTapped {
    //Use goods (Start GoodsController)
    NSArray *controllerNames = @[@"GoodsController", @"GoodsController", @"GoodsController",
        @"GoodsController", @"GoodsController"];
    NSArray *contexts = @[@"Ball", @"Bone", @"Socks", @"Timberine", @"Towel"];

//    [WKInterfaceController reloadRootControllersWithNames:controllerNames contexts:contexts];
    [self presentControllerWithNames:controllerNames contexts:contexts];
//    [self presentControllerWithName:@"PickerController" context:nil];
}

- (IBAction)adventureTapped {
    //Start Adventure SceneController
    [WKInterfaceController reloadRootControllersWithNames:[NSArray
        arrayWithObjects:@"SceneController", nil] contexts:[NSArray
        arrayWithObjects:@"sceneAdventure",nil]];
}

- (IBAction)lostTapped {
    //Start Lost SceneController
//    [self generateArray];
    [WKInterfaceController reloadRootControllersWithNames:[NSArray
        arrayWithObjects:@"SceneController", nil] contexts:[NSArray arrayWithObjects:@"sceneLost",
        nil]];
}

- (IBAction)mameImageTapped {
    //When touch Mamekun, start animation
    if ([self.currentContext isEqual:@"Normal"]) {
    [self.mameImage startAnimatingWithImagesInRange:NSMakeRange(0, 3) duration:1 repeatCount:1];
    NSLog(@"mamekun animation!");
    }
}

@end
```

Figure 3.33: HomeController

```
- (void)sceneLost {
    //set button unhidden
    [self.randomButton setHidden:0];

    //set text
    [self.sceneTextLabel setText:[NSString stringWithFormat:
    @"Mamekun is lost! Stand up and walk around to find him back quickly!"]];

    //set image
    [self.sceneImage setImageNamed:@"sceneLost"];

    //set menu item
    [self addMenuItemWithImageNamed:@"menuIconGoods" title:@"Start" action: @selector(startWalking
        )];
}

- (void)scene1 {
    //set haptic
    [[WKInterfaceDevice currentDevice] playHaptic:WKHapticTypeNotification];

    //set text
    [self.sceneTextLabel setText:[NSString stringWithFormat:@"Maybe a little left...?"]];

    //set image
    [self.sceneImage setImageNamed:@"scene1"];

    //set menu item
    [self addMenuItemWithImageNamed:@"menuIconGoods" title:@"Keep Walking" action: @selector
        (startWalking)];
    //set button unhidden
    [self.okButton setHidden:0];
    [self setTitle:@""];
}

- (void)sceneGoodsBall {
    //set haptic
    [[WKInterfaceDevice currentDevice] playHaptic:WKHapticTypeRetry];

    //set text
    [self.sceneTextLabel setText:[NSString stringWithFormat:@"Found a ball!"]];

    //set image
    [self.sceneImage setImageNamed:@"Ball"];

    //set menu item
    [self addMenuItemWithImageNamed:@"menuIconGoods" title:@"Pick up" action: @selector
        (startWalking)];

    //set button unhidden
    [self.okButton setHidden:0];
    [self.okButton setTitle:@"Pick up"];
    [self setTitle:@""];
    [self.sceneImage setHidden:0];
}
```

Figure 3.34: SceneController

```objc
#import "GoodsController.h"

@interface GoodsController ()
@property (unsafe_unretained, nonatomic) IBOutlet WKInterfaceLabel *goodsNameLabel;
@property (unsafe_unretained, nonatomic) IBOutlet WKInterfaceImage *goodsImage;
@property (nonatomic, strong) NSString *currentContext;
@property (unsafe_unretained, nonatomic) IBOutlet WKInterfaceButton *useButton;

@end

@implementation GoodsController

- (void)awakeWithContext:(id)context {
    [super awakeWithContext:context];

    // Configure interface objects here.
    [self.goodsNameLabel setText:[NSString stringWithFormat:@"%@", context]];
    [self.goodsImage setImageNamed:[NSString stringWithFormat:@"%@", context]];
    self.currentContext = context;
}

- (void)willActivate {
    // This method is called when watch view controller is about to be visible to user
    [super willActivate];
    NSLog(@"%@", self.currentContext);
}

- (void)didDeactivate {
    // This method is called when watch view controller is no longer visible
    [super didDeactivate];
}

- (IBAction)useButtonTapped {
    NSString *contextOfGoods = [NSString stringWithFormat:@"%@", self.currentContext];
    [self dismissController];
    sleep(1);
    [WKInterfaceController reloadRootControllersWithNames:[NSArray
        arrayWithObjects:@"HomeController", nil] contexts:[NSArray arrayWithObjects:contextOfGoods
        , nil]];
    [[WKInterfaceDevice currentDevice] playHaptic:WKHapticTypeSuccess];
}

@end
```

Figure 3.35: GoodsController

3.6 Summary

In this chapter, the concept of the game *Mamekun* is indicated clearly at first, then following with the introduction of the whole design process including two ethnography research and analyses, ideation and prototyping, character and game world design, gameplay design, and implementation of the prototype. To summarize the design of the game *Mamekun* proposed in this research, it is a virtual pet game specifically designed and developed for smartwatch which engages the player to leave the seat to conduct physical activity during the extended gameplay *Finding Mamekun*.

Base on the concept generated from repeatedly operating ideation and prototyping, the character design and the game world design are created. Gameplay *Playing with Mamekun* and *Finding Mamekun* are then developed to fit the game world settings while satisfying the concept of the game. To be able to evaluate the concept of *Mamekun*, essential parts including custom notification system, pedometer data processing and user interfaces of the game, are implemented into the prototype. The evaluation of the working prototype of *Mamekun* will be discussed in the next chapter.

Notes

1 Extended Gameplay is a gameplay extended from the basic entertaining gameplay. "The behavior-changing gameplay provides persuasive mechanisms on top of the basic game mechanics, such as rules, goals, and rewards, and is part of the overall gameplay experience" (Tsang 2014)

2 Tamagawadai Park `http://www.city.ota.tokyo.jp/shisetsu/park/tamagawadai.html`

3 Walkr - Galaxy Adventure in Your Pocket `http://walkrgame.com/en`

4 ねこあつめ公式サイト `http://nekoatsume.com/games/neko/`

5 Toby by Wooga `https://www.wooga.com/games/toby/`

6 Apple Watch - Health and Fitness - Apple `http://www.apple.com/watch/health-and-fitness/`

7 McGonigal, Jane. 2011. *Reality Is Broken: Why Games Make Us Better and How They Can Change the World. Penguin.* 22-27. (McGonigal 2011)

8 Android Wear `https://www.android.com/wear/`

9 watchOS 2 `http://www.apple.com/watchos-2/`

10 Watch App Architecture https://developer.apple.com/library/watchos/documentation/General/Conceptual/WatchKitProgrammingGuide/DesigningaWatchKitApp.html#//apple_ref/doc/uid/TP40014969-CH3-SW1

11 WatchKit https://developer.apple.com/watchkit/

12 Core Motion Framework Reference https://developer.apple.com/library/ios/documentation/CoreMotion/Reference/CoreMotion_Reference/

13 WKInterfaceObject https://developer.apple.com/library/ios/documentation/WatchKit/Reference/WKInterfaceObject_class/index.html#//apple_ref/occ/cl/WKInterfaceObject

14 WatchKit Frameworks Reference https://developer.apple.com/library/ios/documentation/WatchKit/Reference/WatchKit_framework/index.html

15 WKUserNotificationInterfaceController Class Reference https://developer.apple.com/library/ios/documentation/WatchKit/Reference/WKUserNotificationInterfaceController_class/index.html#//apple_ref/occ/cl/WKUserNotificationInterfaceController

16 Core Motion Framework Reference https://developer.apple.com/library/ios/documentation/CoreMotion/Reference/CoreMotion_Reference/

17 CMPedometer Class Reference https://developer.apple.com/library/ios/documentation/CoreMotion/Reference/CMPedometer_class/index.html#//apple_ref/occ/cl/CMPedometer

18 CMPedometerData Class Reference https://developer.apple.com/library/ios/documentation/CoreMotion/Reference/CMPedometerData_class/index.html#//apple_ref/occ/cl/CMPedometerData

19 WKInterfaceController Class Reference https://developer.apple.com/library/ios/documentation/WatchKit/Reference/WKInterfaceController_class/index.html

20 UIViewController Class Reference https://developer.apple.com/library/ios/documentation/UIKit/Reference/UIViewController_Class/

21 WKInterfaceObject https://developer.apple.com/library/ios/documentation/WatchKit/Reference/WKInterfaceObject_class/index.html#//apple_ref/occ/cl/WKInterfaceObject

Chapter 4
Evaluation

This research aims to discourage sedentary lifestyle by breaking sedentary time while also engaging people to conduct physical activity. To achieve this goal, a game called *Mamekun* is proposed. The design concept of *Mamekun* is to provide an attractive virtual pet gameplay "Playing with Mamekun" which can be played anytime, with an extended gameplay "Finding Mamekun" which can only be played when the player receives the notification sent by the game. In the Finding Mamekun gameplay, the player is asked to perform physical activity which is applied to the game experience. In order to demonstrate the feasibility of the game, three main essential parts were implemented into a working prototype: (1) A custom notification system to remind the user to start the game, (2) Using pedometer to detect steps of the player during the game, (3) User interfaces of the game for the player to interact with.

The working prototype contains both two gameplays mentioned above, which is considered as to be able to evaluate the concept of the game. There is a button on the iOS application of *Mamekun*, when the button is tapped, a notification will be sent to the watch which the player is wearing. By tapping the notification showed on the watch, the player can enter the gameplay "Finding Mamekun". The player then asked to follow the instructions shows on the screen to stand up and start to walk around until Mamekun is found by the player. Finally, the player can exit the gameplay and return to the home screen of the game, which means to enter the gameplay "Playing with Mamekun", then use items picked up before during "Finding Mamekun" to play with the character.

The evaluation tries to prove: (1) The game *Mamekun* is attractive and joyful, (2) The game *Mamekun* helps people to reduce sedentary time. The method used to evaluate will be discussed in the next section.

4.1 Evaluation Method

The evaluation which used a working prototype mentioned above was conducted by using qualitative research methods. In-depth interviews methods suggested by Monique Hennink[1] were utilized. In the evaluation, three participants who were considered as the target users of *Mamekun*, were invited to experience the game *Mamekun*. Although the physical space used to conduct evaluation differed from participants, the following two principles were obeyed to obtain the accordance: (1) At least a set of a desk and two chairs in space, (2) An indoor space which is big enough for the player to walk.

Before the evaluation started, the participant was asked to wear the Apple Watch with *Mamekun* installed and sit on the chair to listen to the brief introduction of the game. Then, he or she was asked to wait for the notification from the watch. After the notification sent, the game started, actions of the participant were started to be observed and recorded. There were two focus points for the observation: (1) The emotion of the participant, (2) Behaviors when they interact with the game. Through the observation, how much the participant engages in the game and how the game system is playable, can be evaluated.

After the participant experienced the game, the in-depth interview was conducted. During the interview, the participant will be asked the following questions: (1) Personal background, (2) Normal activity status of a day, (3) Impression of the gameplay and character in *Mamekun*, (4) Option or suggestion to *Mamekun*. Such questions can help to understand the mind of the participant and evaluate whether the game is effective in discouraging sedentary lifestyle. The result of observations and in-depth interviews were recorded and will be discussed in the next section.

4.2 User Test Studies

Three in-depth interviews were conducted after the interviewees experienced *Mamekun*. During the interview, the tendency of sedentary behavior of the interviewee, the impression about the game, and the suggestions for the game, were recorded.

4.2.1 Interview 1

The interviewee of the first interview is a 29-year-old, male, UI (User Interface) designer (Figure 4.1). He works about 9-10 hours a day and spends most of the time sitting in front of the computer. While he noticed that his sedentary time is quite long, currently he does not feel uncomfortable or any injury of his body. When asked if he uses any solution to try to reduce sedentary time, he said that recently he started using sit-stand desk, and he feels it helps him concentrate on the work better although his feet get tired when working for a long time. Also, he is wearing an Apple Watch for more than a half year. He finds that the notification function of Apple Watch which reminds him to stand when sitting too long is quite useful because it is easy to achieve. When getting the notification, he always stand and leave the seat to go to the toilet or just stand to stretch his arms. He can finish the goal of standing at least 1 minute in an hour for 12 times a day (the blue circles showed in Figure 4.2).

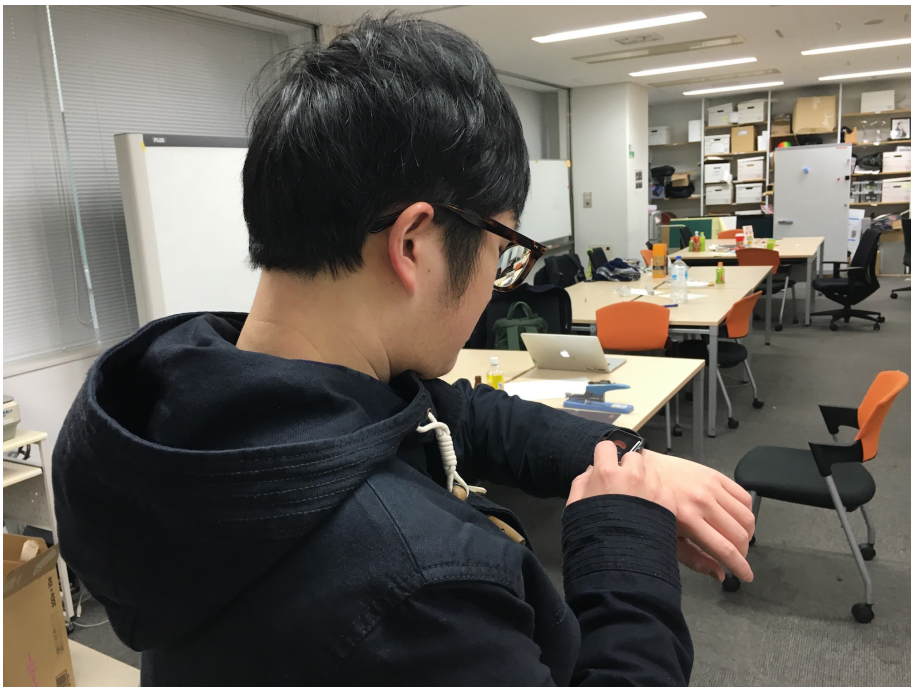


Figure 4.1: The First Interviewee Experiencing *Mamekun*

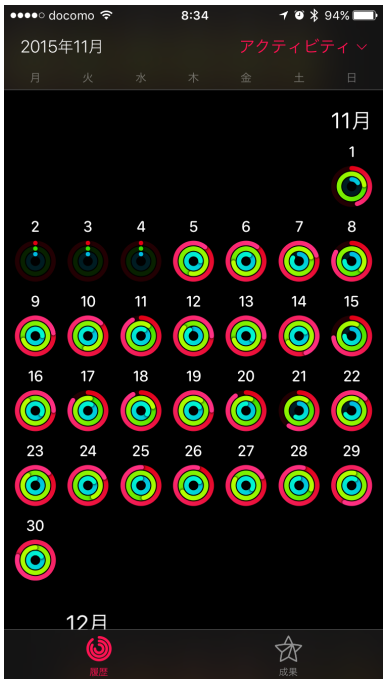


Figure 4.2: Achieving Everyday Goal of Standing

He thinks that *Mamekun* extended the notification function of Apple Watch to a game is very interesting when comparing to just stand for a while. Also, he will be willing to follow the game to walk for a while and leave the current work for a break. He likes the idea of searching a pet and collect items of the game and thinks it is very suitable for the smartwatch. While he said he will be enthusiastic about collecting items if *Mamekun* keeps developing. He suggests the possibility to use the location based technology such as iBeacon to make the items in the game reachable in the real world. Besides, he also recommends utilizing multi-devices to expand the gameplay experience such as letting the player play with the pet on the smartphone. When asked if *Mamekun* can help to motivate him to reduce the sedentary time and conduct the physical activity, the answer is quite positive.

4.2.2 Interview 2

The interviewee of the second interview is a 26-year-old, female, graphic designer (Figure 4.3). Her average working time is about 12 hours which is quite longer

Figure 4.3: The Second Interviewee Experiencing *Mamekun*

than normal people. Similar to the interviewee in the first interview, she also spends most of her time sitting in front of the computer. She said that only during the lunch time she has a little time to move her body. When asked if there was any comfortableness caused by sedentary behavior, she mentioned that she feels sleepy when sitting too long. To fight against the sleepiness, she sometimes goes out to the convenience store for a change of pace. She has raised many pets such as java sparrow, parrot, rabbit, dog, and golden hamster from childhood until now, and showed an interest in experiencing *Mamekun*.

She thinks the character Mamekun is cute and tried to stroke him by touching the watch screen several times. She likes the feature that collected items can be used to feed or play with the character, especially feeding food. She thinks the feature gives her strong motivation to play the game continuously. Although she never used smartwatch before, she can smoothly interact with *Mamekun* without any problems. She said that *Mamekun* makes her want to try and wear the smartwatch during her work. She thinks the walking time of the gameplay *Finding Mamekun* is proper and feel the gameplay can help her to reduce sedentary

time and engage in physical activity. Because of her ample experiences of raising pet, she suggested many features that may be implemented in the future such as enriching the interaction between the character and the player, adding social element, and emphasizing the personality of the pet. Also, she thinks the game will be more attractive if the storyline of the gameplay *Finding Mamekun* can be developed more.

4.2.3 Interview 3

Figure 4.4: The Third Interviewee Experiencing *Mamekun*

The interviewee of the third interview is a 24-year-old, female, graduate student (Figure 4.4). As a graduate student, places she often goes are her home, the library, and the classroom. Her average sedentary time a day is about 10 hours. She said that she often feel her neck uncomfortable because of keeping her eyes fixed on the computer, and her waist also suffers from sitting too long. When at home, she always try hard to break sedentary time by leaving the seat to drink water, eat fruits, and do the housework. While when at the library, she also notice

to not sitting too long by doing things above. She has a habit of going to the gym about 3 times a week. She said that she felt her health status becomes better after got into the habit.

Same with the second interviewee, she also thinks the character Mamekun is cute. Furthermore, she mentioned that the different animations of the character playing different items motivate her to keep playing the game. She thinks although she knows doing physical activity is good for her health, but can hardly practice it. However, the game makes the time of doing physical activity passing fast, which she thinks as a great idea. Besides, she also likes the feature of using notification to remind the user to start the game. She does not have any experience wearing the smartwatch, but after experienced *Mamekun*, she fell in love with the game experience on the smartwatch and even consider to buy one. She suggested mixing a different kind of physical activities into the gameplay to variety the variety of *Mamekun*. Same with the first interviewee, the multi-device design direction was also mentioned by her.

4.3 Proof of Concept

Through the three in-depth interviews, different types of participants who are considered as the target user were invited to experience the game and give comments: Male and female, student and office worker, with and without the experience of wearing smartwatch, with and without the experience of raising pets, with and without the habit of exercise. The average sedentary time of the three participants is quite long. The first participant uses the Apple Watch, and the third participant conducts casual activity and exercise, to try to reduce it. In the interviews, they all agreed that the notification feature of *Mamekun* is effective in reminding them to break the current sedentary behavior and provides them change of pace. Although not all the participants are interested in raising a pet, all of them agreed that the idea of applying the physical activity into a gameplay of searching for a pet and collecting items is certainly motivative. Also, the playing time of the gameplay *Finding Mamekun* is considered as just enough by all the participants. The feature of items collected during the gameplay *Finding Mamekun* can be used to care the character, is regarded as attractive for participants who love pets. All

these comments in the evaluation showed that concept of *Mamekun* is successful conducted by the working prototype.

To conclude, after analyzing the comments during the three in-depth interviews of the evaluation, the aim of this research: To create a game to reduce sedentary time and engage people to conduct physical activity, has been proven to work as predicted while also has many possibilities in the future. The conclusion, discussion, and future discussion of this research will be explained in the next chapter.

Notes

1 Hennink, Monique, Inge Hutter, and Ajay Bailey. 2010. *Qualitative research methods.* Sage,2010. (Hennink et al. 2010)

Chapter 5
Conclusion

5.1 Conclusion

This research describes the design of the game *Mamekun*. *Mamekun* is a game which aims to help people to discourage sedentary lifestyle by breaking sedentary time and engage people to conduct the physical activity. To achieve this goal, a gameplay *Playing with Mamekun* which provides attractive virtual pet game experience that can be played anytime, and an extended gameplay *Finding Mamekun* which applies physical activity into a game experience of searching for pets and collecting items that can be played through the notification of the game, are proposed. In the gameplay *Finding Mamekun*, the smartwatch is implemented to provide visual, auditory, and haptic feedback which provide pervasive game experience. While in the gameplay *Playing with Mamekun*, items collected through *Finding Mamekun* can be used to feed or play with the character Mamekun. Such comprehensive game experience can motivate people to keep playing *Mamekun* continuously. Eventually, the habit of engaging regular physical activity in the daily life can be built, the sedentary lifestyle will be improved.

To design the game *Mamekun*, the ethnography research was first conducted. There were two times of fieldworks were performed. The focus point of the first fieldwork is to understand how people interact with their pets, three groups of people and their pets were observed and interviewed. Through the analysis of the fieldwork, the mental model of people who have a pet was extracted. In the second fieldwork, a female university student was observed and interviewed in order to understand the mental model of a person with a habit of jogging. Based on the analysis of ethnography research, a target persona who is considered as the player of the game was created and used to perform ideation process. Such ideas

were used to generate the initial concept of the game, through the repetition of ideation and prototyping, the final concept of *Mamekun* was created. Based on the concept, the character, game world, and gameplays, were then designed. In order to perform the evaluation to prove the concept of *Mamekun*, a working prototype was implemented. Evaluation using qualitative research method was conducted, and in-depth interviews were utilized. Three participants who were considered as the target user were invited to experience the working prototype of *Mamekun*, and then interviewed after playing the game to asked for their comments. Through the user tests and interviews, the concept of *Mamekun* was proven to work.

5.2 Limitation

This research aims to create a game to encourage people to get rid of sedentary lifestyle by providing an attractive virtual pet game experience. Although the gameplays were carefully designed to keep people playing continuously, however, for people who are not that interesting in raising a pet, the effectiveness of the game still needs to be examined in the long-term user test. Besides, the target user of *Mamekun* is supposed to be the young office worker, and the main user context is also supposed to be the office. Therefore, although there were many ideas about a variety of physical activities which may be able to apply to the game, currently, because of the limitation of the user context, they were abandoned eventually.

5.3 Future Discussion

From suggestions given by interviewees through in-depth interviews, several possibilities for future research are expected to explore based on the design of *Mamekun*.

The first is to utilize multi-devices to provide much more comprehensive pervasive game experience. While this research focuses on only using a smartwatch to cover the whole game, there is no way to deny that multi-devices experience is the trend that has already expanded worldwide. *Mamekun*, for example, could separate two gameplays into the smartphone and smartwatch. Because of the hardware on the smartphone is much powerful than the smartwatch, also, the screen size is quite bigger, interaction and user interfaces of the game could be

freer when comparing to the smartwatch. Location-based technologies could also be implemented to provide more seamless experience between the real world and the game world. However, like what the section *Design Principle of Pervasive Game* mentioned in Chapter 2, there are few threats should be noticed especially when there are several devices are utilized in the game.

The social element is also an important element when designing a game. Relationships between players such as cooperation and competition can effectively encourage the player to act better in the game. With social element introduced into *Mamekun*, it will become interesting to compare collected items to friends, which could enhance the motivation of playing the game. Even the real-time competition of two players both wearing the smartwatch are able to realize.

In the section 5.2, the reason of only including walking in the game was talked. However, it is may become possible to introduce many more different physical activities if the game is able to understand the location context of the player. For example, if the game knows a player is in a unbothered place such as his or her own home, during playing *Finding Mamekun*, the player will be asked to do such as jumping, arm-waving, and more, to play the game. With a variety of physical activities introduced, the playability of the game is expected to increase.

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