

Title	LULL : design of a serious game to improve mental well-being through breathing meditation
Sub Title	
Author	藍, 之均(Lan, Chih Chun) 奥出, 直人(Okude, Naohito)
Publisher	慶應義塾大学大学院メディアデザイン研究科
Publication year	2016
Jtitle	
JaLC DOI	
Abstract	
Notes	修士学位論文. 2016年度メディアデザイン学 第513号
Genre	Thesis or Dissertation
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40001001-00002016-0513

慶應義塾大学学術情報リポジトリ(KOARA)に掲載されているコンテンツの著作権は、それぞれの著作者、学会または出版社/発行者に帰属し、その権利は著作権法によって保護されています。引用にあたっては、著作権法を遵守してご利用ください。

The copyrights of content available on the KeiO Associated Repository of Academic resources (KOARA) belong to the respective authors, academic societies, or publishers/issuers, and these rights are protected by the Japanese Copyright Act. When quoting the content, please follow the Japanese copyright act.

Master's Thesis
Academic Year 2016

LULL

Design of a Serious Game to Improve Mental
Well-Being through Breathing Meditation

Keio University
Graduate School of Media Design

Chih Chun Lan

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

Chih Chun Lan

Thesis Committee:

Professor Naohito Okude (Supervisor)
Professor Hiro Kishi (Co-supervisor)
Professor Sam Furukawa (Member)

Abstract of Master's Thesis of Academic Year 2016

LULL

Design of a Serious Game to Improve Mental Well-Being
through Breathing Meditation

Category: Design

Summary

In the past recent years, living a healthy lifestyle has become a priority. People have increasingly become aware that the continual maintenance of a healthy well-being not only reduces the incidence and impact of future health problems, but also improves quality of life. However, while people pay attention to the food they consume and often have a work out schedule to maintain their physical well-being, the care of a healthy mind and management of stress is one aspect often overlooked.

Lull is an app game designed for users to allow them to improve and strengthen their mental well-being through combining breathing meditation training with serious gameplay. It provides a novel experience for users to practice meditation, ease anxiety and relieve stress. Keeping a healthy mind is important, and through *LULL*, users can relax, refocus and recenter themselves easily during short breaks in their busy lives.

Keywords:

Design, User Experience, Serious Games, Gaming Experience, Meditation Training, Breathing Meditation, Breathing Exercise

Keio University Graduate School of Media Design

Chih Chun Lan

Acknowledgements

First of all, I would like to express my special thanks and deepest gratitude to Professor Okude, not only for his supervision of this research, but also the guidance he provided me throughout my time in KMD and OIKOS. He consistently encouraged me to make this research my own work, but always steered me in the right direction whenever he thought I needed it. I would also like to acknowledge Professor Kishi and Professor Sam as sub-supervisors of this thesis, and I am gratefully indebted to them for their valuable comments on this thesis.

I would like to thank Kevin Fang, PhD student of KMD, for always coming to my aid when I have coding errors, the working prototype of this thesis would not have been possible without his help. Thanks to my thesis buddies, for overcoming thesis challenges alongside me, and sharing all miserable and wonderful moments. Thanks to all the participants who took part in the evaluation process of this research, without their passionate participation and input, the validation could not have been successfully conducted. Thanks to all my friends for their mental support through difficult times.

Finally, I must express my very profound gratitude and affection to the best people in the world, my parents, my sister and to Darrien Tu, my boyfriend, for providing me with unfailing support, continuous encouragement, and unconditional love throughout my study and through the process of writing this thesis.

Table of Contents

Acknowledgements	ii
1 Introduction	1
1.1 Background	1
1.2 Occupational Stress	2
1.3 Breathing Meditation Exercise	3
1.4 Gamification	3
1.5 Concept	4
Notes	5
2 Literature Review	7
2.1 Approaches for Stress Relief	7
2.2 Meditation, Mindfulness and Deep Breathing Exercise	9
2.2.1 Meditation Programs	9
2.2.2 The Benefits of Breathing Exercise	10
2.2.3 Breathing Training on Mobile Apps	11
2.3 Serious Games	11
2.3.1 The Impact of Digital Games	11
2.3.2 Game Mechanics for Serious Games	12
2.3.3 Serious Games for Health	13
2.4 Contribution of this Research	13
Notes	14
3 Design	16
3.1 Design Concept	16
3.2 Ethnography Research	18
3.2.1 Understanding Users	18
3.2.2 Understanding Meditation Practitioners	25
3.2.3 Target Persona	26
3.3 Ideation	28

TABLE OF CONTENTS

3.3.1	Brainstorming	28
3.3.2	Concept Sketching	29
3.3.3	Rough Prototyping	31
3.4	Game Design	31
3.4.1	User Experience	32
3.4.2	Characters	34
3.4.3	Game World	37
3.4.4	Gameplay	41
3.4.5	Game Reward System	44
3.5	Prototyping Process	45
3.5.1	Program Structure	45
3.5.2	Implementation	48
3.6	Design Summary	50
	Notes	50
4	Evaluation	51
4.1	Evaluation Method	51
4.2	Results	52
4.2.1	Evaluation Using Wearable Device	60
4.3	Proof of Concept	63
4.3.1	Game Experience	63
4.3.2	Stress Reduction	64
4.3.3	Measured Mental Status	65
4.3.4	Summary	66
	Notes	66
5	Conclusion	67
5.1	Design Approach	67
5.2	Limitations	68
5.3	Future Discussions	69
	References	71
	Appendices	74
A	Game Interface Design	74
B	Concept Video	75
C	Codes in C Sharp	78

TABLE OF CONTENTS

C.1	Touch Control Codes	78
C.2	Points Codes	79
C.3	Select Character Codes	81

List of Figures

3.1	Ivy	18
3.2	Ivy's Flow Model	19
3.3	Ivy's Physical Model	20
3.4	Ivy's Mental Model A	21
3.5	Ivy's Mental Model B	21
3.6	Suki	22
3.7	A Day With Suki	23
3.8	Suki's Flow Model	23
3.9	Suki's Mental Model	24
3.10	During Breathing Meditation Exercise	25
3.11	Target Persona	27
3.12	Brainstorming	28
3.13	Brainstorming 2	29
3.14	Concept Sketch 1	30
3.15	Concept Sketch 2	30
3.16	Rough Prototype Testing	31
3.17	User Experience Flow	33
3.18	User Interface Flow	33
3.19	Character Design: Version 1	35
3.20	Character Design: Version 2	35
3.21	Character Design: Version 3	36
3.22	Game Story	37
3.23	Game World	38
3.24	Game World: Level a)Puff Master b)Esta Egg	39
3.25	Game World: Darkness	40
3.26	Tutorial	41
3.27	Gameplay	43
3.28	Puff Master's Breathing Animation	46
3.29	Esta Egg's Breathing Animation	46

LIST OF FIGURES

3.30	Control Orb	47
3.31	Code for Point System	48
3.32	Level: Puff Master	49
3.33	Level: Esta Egg	49
4.1	Interviewee 1	52
4.2	Participant 1 In-game	53
4.3	Interviewee 2	54
4.4	Participant 2 In-game	55
4.5	Interviewee 3	56
4.6	Participant 3 In-game	57
4.7	Interviewee 4	58
4.8	Participant 4 In-game	59
4.9	Interviewee 5	60
4.10	Participant 5 In-game	62
4.11	Results Graph	64
4.12	Results Graph	65
4.13	Results Graph	66
A.1	Game Interface Design	74
B.1	Concept Video	75
B.2	Concept Video	76
B.3	Concept Video	77

List of Tables

4.1	Subject Five Respiration Rate	63
-----	---	----

Chapter 1

Introduction

1.1 Background

This research aims to create an app game, *LULL*, for busy young adults to improve their mental well-being through a short guided session of breathing meditation interfaced by a serious gaming experience. Such a design will help ease anxiety and reduce stress, hence improving their mental well-being.

Everyone has felt the effects of minor depression and overwhelming stress at times, with young adults being one of the largest at risk demographics. In a survey conducted by American Psychological Association in 2012, Millennials and Gen Xers reporting an average stress level of 5.4 on a 10-point scale where 1 is little or no stress and 10 is a great deal of stress. This is far higher than Boomers' average stress level of 4.7 and Matures' average stress level of 3.7" ¹. Young adults are finding it hard to manage their stress, and 76 percent of all Millennials express that work is a significant contributor towards their collective stress.

Work is one of the main stress factors for the modern lifestyle. Mental health and stress influences performance and effectiveness at work. Through past research conducted on stress, the primary level of stress causes psychological, physiological, and psychosomatic effects leading to symptoms such as fear, tension, anxiety, sleep disturbance, headache and fatigue. Therefore, in promoting positive mental well-being, young adult office workers can increase their resilience to cope with difficulties in work, fulfill their potential and enjoy their job.

When coping with stress, social and physical activities seem to be two useful solutions ², however, these are difficult methods to pursue during working hours. Dealing with short term occupational stress, requires a more effective but short term approach since it is difficult to leave the office while at work. Taking a short coffee break or washroom break is often the solution busy workers employ to reduce stress whilst at work.

The goal of *LULL* is to help young adults manage and maintain their mental

well-being, through providing a short but effective stress relieving experience as an easily accessible and approachable solution. If the designed concept is proven successful, it will guide users to learn to better manage stress and improve mental well-being.

1.2 Occupational Stress

As mentioned earlier, occupational stress is one of the main causes of stress in our daily lives. To define stress, it can be thought of as (a) a feature of the external environment that acts on an individual, (b) the individuals responses (psychological, physiological, and behavioral) to environmental demands, threats, and challenges, or (c) the interaction of the two.³ Because work is such an integral part of our lives and such a large portion of time is devoted to it, it inevitably creates moments of intense stress.

Since everyones working environment is very different, and the stress levels that each individual experiences is also different considering personality, working ability, and other factors. It is hard to find a solution that fits in all criteria to suit every office including every employee. Therefore, this research will focus on trying to solve the problem through each individual rather than approaching through a systemic intervention.

There are multitude of previous research for individuals on how to cope with work-related stress and most often mentions physical activities and social activities. These two methods are quite effective in generating a change of mind, environment, and reversing negative thoughts. Physical and social activities may be a good way to relax after working hours or on weekends to help with chronic stress, however, while during working hours and in a serious working environment it might be difficult to engage in such activities to be effective of reducing stress.

Through previous fieldwork conducted on office workers, which will be further discussed in Chapter 3, the actions employees pursue to relieve stress during work are some of the following: (a) take a longer walk during lunch break, (b) change of working environment and (c) playing games with colleagues. All these actions help reduce stress and lead to the same result - clearing of the mind. By clearing their mind, it helps them relax their brains and regain focus after getting rid of the stress stimuli. However, not all workers are lucky enough to have the privilege or time to leave their desk as long as they wish, or interact with coworkers about non-work-related issues during work.

1.3 Breathing Meditation Exercise

In recent years, mindfulness, meditation and yoga are becoming a lifestyle trend and as viable solutions to release stress and improve mental well-being. In the research article, "Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response"⁴, it concludes that yoga and meditation significantly reduced stress compared to the control group. The experiment measured the participants heart rate and respiration rate starting 5 minutes throughout the exercise, and showed significant difference in the first check point between 5-10 minutes throughout the exercises.

This hints that short term breathing meditation exercises may be a good solution. Short term meditation helps clear the mind and ease anxiety, as mentioned by Goyal M in "Meditation programs for psychological stress and well-being: A systematic review and meta-analysis"⁵. It can be a low-cost, self-directed stress reduction method to stress relief in the office environment. As such, a one to five minutes meditation session can lower heart rate and respiration rate that leads to relieving anxiety and stress in a short period of time, and can leave workers with a clear mind to continue working again in just a few minutes. This research aims to embed breathing exercises into young office workers' lifestyle to help manage their stress while at work.

However, the term meditation can be unfamiliar to most people such as beginners without meditation training or guidance can find it difficult and uninteresting to sit through a meditation session thus becoming counteractive in establishing a habit or act that employees can pursue when they are feeling stress and anxiety. How to embed these specific breath exercises and training into their life-style becomes a problem and where this thesis' research aims to intervene in employing short term meditation into a game to overcome this challenge.

1.4 Gamification

In the article "From game design elements to gamefulness: defining "gamification""⁶, Sebastian Deterding suggests that "under the moniker gamification, this idea is spawning an intense public debate as well as numerous applications ranging across productivity, finance, health, education, sustainability, as well as news and entertainment media."⁶ gamification, in essence, provides a reward system in a designed game world that motivates users to use the system or service proac-

tively, and can be a good solution to entrench breathing meditation into the lives of young adult workers in this research.

Many terms have emerged in the past decade under the term gamification with pervasive games and serious games among them. Serious games, is defined as a game that serves the purpose of not only solely entertainment, but also has a serious purpose, such as education, training, or information. Through serious games, users can benefit in a fun and playful way while gaining a benefit more than just pure entertainment. In this research, the specific benefits for users will be learning the basics of meditation, and gaining the habit of pursuing meditation whenever under pressure.

Through designing a serious game that gamifies breathing meditation exercise it: (1) educates players on how to meditate and relieve stress, (2) motivates users in engaging in breathing meditation through a interactive and enjoyable experience, and (3) changes a user's behavior and naturally improves their mental well-being.

Compared to medical devices or personal meditation training systems, games are not only easier for users to adopt into their daily lifestyle but also has the potential in motivating users to continue use over a longer period of time and builds a strong platform for a positive habit. The game designed will have the elements of entertaining games but embed a secondary layer to overcome the challenge mentioned earlier and further ethnography research and game design formulas will be used complete the concept.

1.5 Concept

Maintaining a consistent state of mental well-being and stress management is a challenge in the fast paced lives experienced by young adults in the modern workforce.

This research proposes *LULL*, a smart phone app game that addresses this problem by helping maintain a healthy mental state through guiding young adult workers in managing occupational stress and improving mental well being. By embedding the basic foundation of meditation and mindfulness into a serious game, it allows users to access breathing meditation exercises almost anytime, anywhere. The game also provides an interesting and engaging way to participate thus motivating users to practice breathing meditation exercise to build a strong premise in overcoming stress.

As mentioned previously, *LULL* is a serious game and will serve the purpose of educating and training than mere entertainment. One of the main goals of *LULL* is to provide effective breathing training for users. However, it also needs to have the basic elements of a fun game. In order to achieve that goal, the characters in the constructed game world are designed to act as companions and guides to teach the steps of breathing meditation.

In order to create an effective breathing meditation guide, observational research was conducted on a seasoned breathing meditation practitioner and shepherd the persuasive breathing experience found in the gameplay. Characters are designed in detail to mimic the breathing rhythm of breathing exercise practitioners and act as the user's meditation partners and trainer throughout the process.

A total of ten individual characters were designed for *LULL*. In the gameplay, the user's goal is to match their own breathing to the character of their choosing, and defeat Darkness throughout the process. Darkness is the villain designed for the game who casts a dark shadow over the *LULL* world. By breathing alongside the character, users help the character gain new energy to triumph over the enveloping shadow. Each character unlock yields a more progressively difficult breathing regiment for the user and can be gained by completing a perfect meditation session in an easier rank.

Serving as a quick solution to occupational stress, *LULL* therefore has to be designed to be easily accessible and act as a short break from the stressful situation. It will be published as a smart phone app game on the Apple iOS platform with developments into future platforms such as Android and PC. Users can easily access their phone during a short break or access it during their commute, to relax and refocus.

LULL transforms monotonous and mundane process of meditation training into interesting, engaging gameplay. By using *LULL*, not only can the users learn breathing meditation exercises and enjoy the process through gameplay, but also provides tangible health benefits through reducing stress and improvement of their mental well-being.

Notes

- 1 American Psychological Association, Stress by Generations (Association 2012)
- 2 Timothy J. Schoenfeld, Pedro Rada, Pedro R. Pieruzzini, Brian Hsueh, and Elizabeth Gould. Physical Exercise Prevents Stress-Induced Activation of Granule Neurons and Enhances Local Inhibitory Mechanisms in the Dentate Gyrus (Timothy J. Schoenfeld 2013)

- 3 Tomaka, Joe. U Texas, Dept of Psychology, El Paso, US Blascovich, and Jim. Effects of justice beliefs on cognitive appraisal of and subjective physiological, and behavioral responses to potential stress (Tomaka 1994)
- 4 Melville Geoffrey W, Chang Dennis, Colagiuri Ben, Marshall Paul W., and Cheema Birinder S. Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response (med 2199)
- 5 Goyal M and Singh S and Sibinga ES and et al. Meditation programs for psychological stress and well-being: A systematic review and meta-analysis (M et al. 2014)
- 6 Deterding, Sebastian and Dixon, Dan and Khaled, Rilla and Nacke, Lennart. From game design elements to gamefulness: defining "gamification"(Deterding et al. 2011)

Chapter 2

Literature Review

As mentioned in the last chapter, this research aims to design a serious game that improves mental well-being by combining (1) meditation training with (2) serious gaming experience. Based on the concept mentioned in the previous chapter, (1) stress releasing approaches, (2) meditation training and (3) serious gaming are closely related to this research, and will be further discussed in this chapter.

2.1 Approaches for Stress Relief

Stress has become a major health problem in modern society, the importance of mental well-being is crucial. Some approaches for stress releasing will be further discussed.

In the article "Process evaluation for organizational stress and well-being interventions: Implications for theory, method, and practice." ¹ it states that although there are evidence showing psychological risks of occupational stress, however, it is still complex to interfere through organizational interventions. Every individual, environment and situation is special when approaching stress. Hence, this research approaches stress relief through other individual solutions.

The other obvious approach to stress is physical exercise, physical exercise is known to reduce anxiety. In the research "Physical Exercise Prevents Stress-Induced Activation of Granule Neurons and Enhances Local Inhibitory Mechanisms in the Dentate Gyrus" published in The Journal of Neuroscience in 2013 ², there was an interesting experiment done on sedentary rodents and runner rodents. The runners group was provided an external running wheel, while the sedentary rodents were only provided food and water. As a result, Timothy J. Schoenfeld concludes that "running increases the number of new neurons in the dentate gyrus and decreases anxiety-like behavior. Running and physical exercise is proven to be an effective way to release stress. However, running and other

physical exercise is not a convenient option to pursue anytime anywhere. Not only is physical exercise limited by location, but also is limited by time, too short a session of physical exercise may not be as effective. It may be a good solution for busy workers to rid their occupational stress after work, on the weekends, or when they have more time.

In another research published by Manoj, Sharma in *Journal of Evidence-Based Complementary and Alternative Medicine* ³, it concludes yoga as an alternative and complimentary approach for stress management. The research examined the researches done on stress release through yoga conducted throughout 2001 to May 2013, as a conclusion, the research shows that yoga is a promising solution for stress management. Also, in the article "Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response" ⁴, it measured the participants stress levels through heart rate and respiratory rate, which proves that conducting a short session of yoga practice or meditation can relieve stress. However, similar to running, although it requires little stretching space, it is mandatory to have enough space to practice yoga, and requires advanced guidance starting as a beginner, therefore, it is not the best solution to seek out to reduce stress while at work. The other solution mentioned by Melville Geoffrey W in the article was meditation. Meditation only requires practitioners to sit or stand in a comfortable posture, which is a minimal of space for practicing any exercise, and would only take a short period of time to complete. Therefore, meditation seems like a more adaptable solution for busy young adults and will be further discussed.

Meditation as another approach for stress release, study indicates that meditation has many health benefits, and reduces psychological stress and stress-related health problems. More and more people are aware the benefits of meditation in the current years, and a variety of practices and training were designed. Different from active exercise and yoga, meditation training requires minimal space, and can be done by mostly anyone, anywhere, at anytime.

This research aims to find a solution for stressed users to be able to relax and refocus in a short amount of time anytime, anywhere in a easy and simple way, therefore, short term meditation seems like the better approach.

2.2 Meditation, Mindfulness and Deep Breathing Exercise

2.2.1 Meditation Programs

There are many different types of meditation programs. The article Meditation Programs for Psychological Stress and well-being: A Systematic Review and Meta-analysis ⁵ reviewed various types of different meditation programs. As a result of the review, it indicates that meditation programs can reduce the negative dimensions of psychological stress. However, there are many different methods and formulas in meditation practice, this research will look into mindfulness-based stress reduction (MBSR).

In William R. Marchands research on meditation and mindfulness practice ⁶, describes meditation as a practice of paying attention to a moment-to-moment experience. In recent years, it has become increasingly popular as a method to support medical and psychiatric conditions. The research looks into three types of meditation and mindfulness practice, Zen meditation, mindfulness-based stress reduction (MBSR), and mindfulness-based cognitive therapy (MBCT). All three types of meditation practice are originated from Buddhist spiritual practices, but only Zen considered traditional religious practice. MBSR and MBCT can both be considered as modern meditation practice, which has been modified for stress and anxiety reduction. The research pointed out three main focuses in mindfulness practice, (1) intention, (2) attention, and (3) attitude. For patients, their intention in mindfulness would be to reduce depression, ease anxiety, and decrease pain. Their attention facilitates their moment-to-moment experience, while their attitude should promote self-acceptance and compassion. There are several differences in Zen practice, MBSR and MBCT, however, they all have positive effects on mood, anxiety, and pain symptoms in both psychological and biological ways.

In another research published by the Annals of the New York Academy of Sciences, "Classical Mindfulness: An Introduction to Its Theory and Practice for Clinical Application" ⁷, it introduces classic meditation practices and modern meditation practices. Modern practices of mindfulness are mostly used as a formula for stress reduction, MBSR, mindfulness based stress reduction. Modern MBSR simplifies the classic practice of meditation to only being mindful of the situation and the present experience. Different from classic meditation, attention

and acceptance are the only key features of modern MBSR. The popularity of MBSR motivated practitioners to simplify MBSR from the formal classical practice, to make it more adaptable and accessible. While there are many differences in classical meditation and modern meditation, the breath is important in both practices, it is the basics of mindfulness and meditation.

A simplified method of MBSR practice can be considered while designing the concept of *LULL*.

2.2.2 The Benefits of Breathing Exercise

Similar to yoga breathing, basic breathing practice for meditation aims for deep steady breathing, into the chest and into the abdomen. Focused breathing is the most basics of meditation training and yoga practice, according to previous studies, breathing exercises serves a good effect on releasing stress and anxiety. In recent years, there are research and studies to embed breathing meditation education in school curriculum for better focus and emotional stability in children. This research focuses on bringing the basics experience of meditation practice into everyday life for adults, for users who feels stressed at moments and need a quick break to relax and focus.

In a research conducted on medical students, "A Longitudinal Study of Students Perceptions of Using Deep Breathing Meditation to Reduce Testing Stresses"⁸, it proves the effects on stress reducing through conducting deep breathing meditation. A curriculum component was designed for students preparing for medical school, to help students develop and practice stress managing techniques. Deep Breathing Meditation, DBM, was embedded into two classes, while the students are asked to participate in DBM and completed pre-, post-, and follow-up surveys each academic year.

As a result, even though 67 % of the students have never experienced DBM before the course, 100 % of the students reported using DBM as a method to reduce stress and anxiety even when they are not in class. 57 % of the students reported to use this method only when needed, while the other 42 % reported to practice DBM on their own over 4 times per week. In the surveys conducted to analyze the results, the students were asked six areas of questions surrounding anxiety and stress levels. Within the survey after the first six weeks, the students reported significant change. Students experienced less test anxiety, nervousness, and self-doubt, in addition to increased concentration during exams. Through the follow-up survey, the students reported to use DBM in other courses and believe

that DBM can help them academically.

DBM is a simple and easy way to start mindfulness or meditation practice, therefore, this research will focus on embedding DBM into the designed concept to help improve the mental well-being of busy young adults.

2.2.3 Breathing Training on Mobile Apps

The research "Evaluating mobile apps for breathing training: The effectiveness of visualization" ⁹, analyzed the effectiveness of smart phone apps on breathing training. The popularity of smartphones has enormously increased in the past decade, therefore, smartphones has become an easily accessible device with the potential to act as a medical-health-training device, since it follows the users anywhere almost at all times. Traditional breathing training was conducted with participants and trainers in the same space, and participants follow the given voice instructions on how to breath, however, being in the same space with the trainers give participants the opportunity to observe and learn faster from the trainer. In recent years, there has been a growing number of breathing training apps, that were developed by small companies and big organizations. The research focuses on an evaluation of such apps. Participants were asked to relax for one minute, then required to use the apps and follow the instructions of the apps as closely as possible. A more traditional audio-only training app with breathing instructions was evaluated with two other visualized training apps. One of the visualized training apps used different colors and count to indicate inhale and exhale, while the other used waves to indicate the rhythm of breathing. Results showed significant difference in objective and subjective terms, through visualization training apps, the users found it easier to follow and relax.

However, by only visualizing breathing training does not create fun factors to motivate users to continue training in an interesting way, therefore, serious gamification was embedded and will be further researched.

2.3 Serious Games

2.3.1 The Impact of Digital Games

Over the recent years, study shows that games can offer a wider outcome and impact more than mere entertainment, which are Serious Games. Ever since introduced 40 years ago, digital games have proved to be highly engaging activities,

however, why games are engaging are not well understood. The research review done in 2012 by Elizabeth A. Boyle, Engagement in digital entertainment games: A systematic review ¹⁰, indicates the impact of developing digital games, and addresses the key to the entertainment of games. In Elizabeth A. Boyle's review, it discussed the motives/reason for playing games. Enjoyable experience in the designed game world leads to positive attitudes and expectations of a game, therefore enhances the motive for users to play the game.

In another research "The role of psychology in understanding the impact of computer games" ¹¹ also by Elizabeth A. Boyle, discussed the negative and positive impacts on game players. These impacts are identified by psychologists, some negative impacts include video violence, gender stereotyping and addictions. Positive impacts, on the other hand, include engagement, and subjective feelings during gameplay. More discussion was on the perceptual and cognitive impact of entertainment games. Action game players are proven to have better visuomotor coordination and spatial representation, iconic skills and visual attention. ¹² Serious games are games that serve a higher purpose than mere entertainment, they are intentionally designed for learning, skill acquisition and training. This leads to further research on learning or training through games.

2.3.2 Game Mechanics for Serious Games

All games are designed to bring players into a different world with the rules of gameplay, in the game world designed, players should be able to enjoy the experience. Sylvester Arnab analyzed the methods and components of a serious game ¹³, in his research "Mapping learning and game mechanics for serious games analysis". The research formulated a Learning Mechanics (LM) and Games Mechanics (GM) model to analyze and design Serious Game Mechanics (SGMs). SGMs are the game components that translate pedagogy, learning and entertainment/fun into concrete game mechanics directly for the players to perceive by their actions.

LM-GM maps can be organized into two axes, with LM and GM on the top, and components running down vertically as roots. The core components are categorized in the center, while the supporting components run along the side of the core components. The LM-GM model should be adjusted by each user when used in design for each game situation, for example, "thinking skills" can be generated through the LM-GM model, then can be used to explore further on "implementation" and "usage". Which can be useful in the process of designing the SGMs of the game.

2.3.3 Serious Games for Health

”Impact of a serious game for health on chronic disease self-management: Preliminary efficacy among community dwelling adults with hypertension”¹⁴ is a research based on embedding a serious game to educate and help prevent adults on chronic disease, such as hypertension (HTN). An experiment was sought out to explore the impacts of a designed serious game, a sample of 116 adults with HTN was enrolled as participants in this research. Participants were randomly assigned in two groups, (1) intervention using a serious game for health (eSMART-HD) or (2) a control group exposed to screen-based HTN education.

The serious game, eSMART-HD, was designed to simulate conditions of interacting with avatar-based healthcare professionals. It provides cognitive and behavioral strategies in a nonthreatening virtual environment for players to interact with virtual characters. Which improves their interactions with their ”real life” healthcare providers, thus better their chronic disease self-care management.

The primary data collected was blood pressure over a four month trial. As a result, there was no significant difference between-groups in blood pressure reduction over the four months, however, within-group reduction showed a compelling difference. Over time, the control group showed no significant change in their systolic and blood reductions, in contrast, participants assigned to participate in the eSMART-HD group, showed significant improvements in their systolic and blood reductions. To conclude, the research provided proof of efficacy of a serious game for health to educate, train, and improve blood pressure control among community dwelling adults.

Serious games for health is a new area of research for serious games, previous research has proved that using SGs as a solution to educate patients on chronic disease is positive, however, there are none yet discussing the improvement of mental well-being. In this research, *LULL* aims to provide a solution for stress reduction and improve mental well-being among young busy adults, thus previous researches encourages this research to create a SG to engage users in deep breathing meditation.

2.4 Contribution of this Research

This research addresses a global issue of stress in young adults, and aims to create an engaging experience to enhance stress management. *LULL* approaches the

most basic of meditation training, deep breathing meditation, from a gamification approach to offer a new solution to reduce stress. Not only does this give users the chance to start practicing meditation and mindfulness to release stress in a fun and interesting way, gamification will also motivate and engage users to continue the training for the long run, and lead to improved mental well-being and better quality in life for the user.

Hence, the success of this research can contribute further research of serious gaming experience for patients or non-patients for improvement of mental well-being and other medical purposes.

The design process and user experience designs will be further explained in the next chapter.

Notes

- 1 Biron, Caroline and Karanika-Murray, Maria. Process evaluation for organizational stress and well-being interventions: Implications for theory, method, and practice. (Biron and Karanika-Murray 2014)
- 2 Timothy J. Schoenfeld, Pedro Rada, Pedro R. Pieruzzini, Brian Hsueh, and Elizabeth Gould. Physical Exercise Prevents Stress-Induced Activation of Granule Neurons and Enhances Local Inhibitory Mechanisms in the Dentate Gyrus. (Timothy J. Schoenfeld 2013)
- 3 Sharma, Manoj. Yoga as an Alternative and Complementary Approach for Stress Management: A Systematic Review. (Sharma 2014)
- 4 Melville Geoffrey W, Chang Dennis, Colagiuri Ben, Marshall Paul W., and Cheema Birinder S. Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response. (med 2199)
- 5 Goyal M, Singh S, Sibinga ES and et al. Meditation programs for psychological stress and well-being: A systematic review and meta-analysis. (M et al. 2014)
- 6 MARCHAND, and WILLIAM R. MD. Mindfulness-based stress reduction, mindfulness-based cognitive therapy, and Zen meditation for depression, anxiety, pain, and psychological distress. (MARCHAND 2012)
- 7 Rapgay, Lobsang and Bystrisky, Alexander. Classical Mindfulness. (Rapgay and Bystrisky 2009)
- 8 Gina Paul, Barb Elam, and Steven J. Verhulst. A Longitudinal Study of Students' Perceptions of Using Deep Breathing Meditation to Reduce Testing Stresses. (Paul et al. 2007)
- 9 Luca Chittaro, and Riccardo Sioni. Evaluating mobile apps for breathing training: The effectiveness of visualization. (Chittaro and Sioni 2014)
- 10 Elizabeth A. Boyle and Thomas M. Connolly and Thomas Hainey and James M. Boyle. Engagement in digital entertainment games: A systematic review. (Boyle et al. 2012)

- 11 Elizabeth Boyle and Thomas M. Connolly and Thomas Hailey. The role of psychology in understanding the impact of computer games. (Boyle et al. 2011)
- 12 C.S. Green and D. Bavelier. Enumeration versus multiple object tracking: the case of action video game players. (Green and Bavelier 2006)
- 13 Arnab, Sylvester and Lim, Theodore and Carvalho, Maira B. and Bellotti, Francesco and de Freitas, Sara and Louchart, Sandy and Suttie, Neil and Berta, Riccardo and De Gloria, Alessandro. Mapping learning and game mechanics for serious games analysis(Arnab et al. 2015)
- 14 HICKMAN JR., RONALD L. and CLOCHESY, JOHN M. and PINTO, MELISSA D. and BURANT, CHRISTOPHER and PIGNATIELLO, GRANT and Hickman, Ronald L Jr. IMPACT OF A SERIOUS GAME FOR HEALTH ON CHRONIC DISEASE SELF-MANAGEMENT: PRELIMINARY EFFICACY AMONG COMMUNITY DWELLING ADULTS WITH HYPERTENSION.(HICKMAN JR. et al. 2015)

Chapter 3

Design

The goal of this research is to achieve stress reduction and mental well-being for users in a easily accessible and interesting way, without making them feel disturbed or stressed as using a medical device or as attending serious training sessions. By guiding users through a short session of Deep Breathing Meditation on a smartphone platform, it is easily accessible and reduces stress, hence improve their mental well-being. Approaching this process through serious gaming experience can help educate and train users on DBM in an interesting and engaging way. Therefore, a game needs to be designed, throughout the design process, it is critical to keep in mind that the ultimate goal is to find a balance between Deep Breathing Meditation and fun entertaining gameplay. This chapter will further introduce the concept, user research, design process and implementation.

3.1 Design Concept

LULL is a smart phone app game for young busy adults to access anywhere, when they are in stressful situations. By guiding them to do Deep Breathing Meditation through gaming experience, it helps reduce stress and acts as a short break for the mind. Based on previous research and science background of meditation and breathing exercise, Deep Breathing Meditation (DBM) training is embed into the game to provide a solution for stress reduction. The designed game is formed by these main features:

1. Engages users to complete a one to five minute of breathing meditation session guided by cute breathing companions throughout the gameplay.
2. Visualizes stress and depression as an abstract villain, Darkness, in the game for users to overcome both in the game and outside the game through practicing DBM.

3. Motivates users to play often as it unlocks new characters and keeps the former characters active.
4. Easy to access as a short break for the mind whenever feeling stressful.

A total of ten characters are designed in *LULL*. The characters each represent a different level and individually guides users through a session of DBM. Throughout the gameplay of each individual character, the character breaths in a steady and slow rhythm to guide the player, while the player has to match their own breathing rhythm to the character. A light orb acts as the control in the gameplay to indicate the player's breathing rhythm. By touching the orb on the screen, it scales bigger to indicate the user is breathing in, when removing the finger tip from the orb, it scales down to indicate that the user is breathing out. Via matching the users breathing rhythm and the orb's scaling rhythm with the character, it slows down and steady users respiration rate.

The cute characters guides as a DBM trainer, while collecting and unlocking the characters acts as a fun factor and reward for the players after completing the DBM challenge. Additionally, the light orb, which acts as a controller, provides users a simple press and release interaction to focus on in the game. The easy and rhythmic movement not only engages users in interacting with the character during the static process, but also acts as an easy challenge factor for users to master and conquer in the game. By matching the scaling rhythm of the orb perfectly to the breathing rhythm of the character throughout the level, it unlocks the next character, and keeps the current character active.

The approach to embed DBM training into users lives is through designing a serious game. Fun elements and reward systems designed in the game will provide a motivation for users to continue the training, hence, naturally guide users to practice breathing meditation. Further design on the gameplay experience will be discussed in Chapter 3.4. *LULL* is available for users to play almost anytime anywhere, and acts as a short break for users. In the long term, users will slowly experience the benefits of Deep Breathing Meditation, such as stress reduction and improvement of mental well-being, thus adapt to it as a habit, it can also become a go-to solution for whenever they feel stressed. The design process will be further discussed in this chapter.

3.2 Ethnography Research

This research began with the vision of designing a cute, stress free and inspiring health companion for busy workers. Hence, observational research, fieldwork, was conducted on potential users, two young female office employees, to understand how office workers relieve stress and live a healthy life style. By observing and interviewing the potential user, several insights are defined during the process.

3.2.1 Understanding Users



Figure 3.1: Ivy

Fieldwork One The first fieldwork was conducted on July 13th 2016 on Ivy Li, a young female full-time Designer working in a design consultancy in Tokyo (Figure 3.1). She lives in Tokyo on her own, while her other family members live in Taiwan.

During the fieldwork, Ivy mentioned swimming several times every week to help her relax and stay focused throughout the week. Throughout her day at work,

she encountered some difficulties in coming up with a T-shirt idea for the company, she started scrolling through Pinterest to find inspirations, then decided to have an early lunch to freshen up. After lunch, she changed working environments from her desk on the first floor to the second floor meeting room in the office to refocus and finish her work. In the afternoon meeting with the whole company, she engaged in a game of Bingo with her co-workers. The Bingo game is played while the boss is talking during the meeting, the boxes are filled with words that the boss commonly uses, then while the boss presents during the meeting, the game is conducted. It helps the employees keep a relaxed mind and stay focused at the same time during the meeting. The *Flow Model* indicates the interactions and actions Ivy pursued throughout her day, and actions she mentioned after the fieldwork that involves releasing stress (Figure 3.2).

Physical Model indicates the brief map of Ivys office environment, where the fieldwork took place (Figure 3.3).

Swimming and *change* are key words that Ivy mentioned several times during the fieldwork, swimming is a very important action she takes after work when she feels anxiety and work stress, however, during her working hours, *change* and *refresh* are the keys to help her stay focused and relaxed. Ivy's cognitive behavior was analyzed as mental models shown in Figure 3.4 and 3.5.

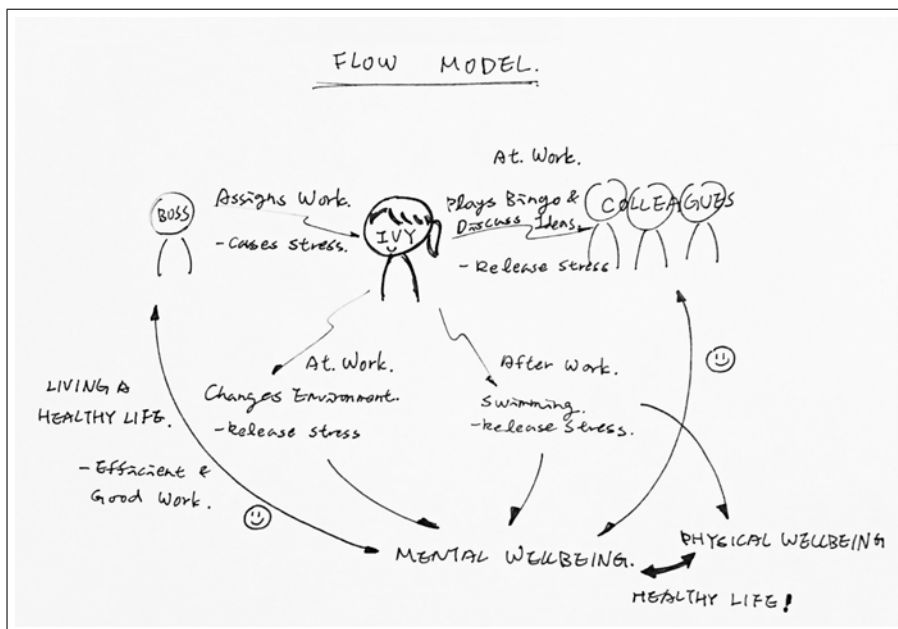


Figure 3.2: Ivy's Flow Model

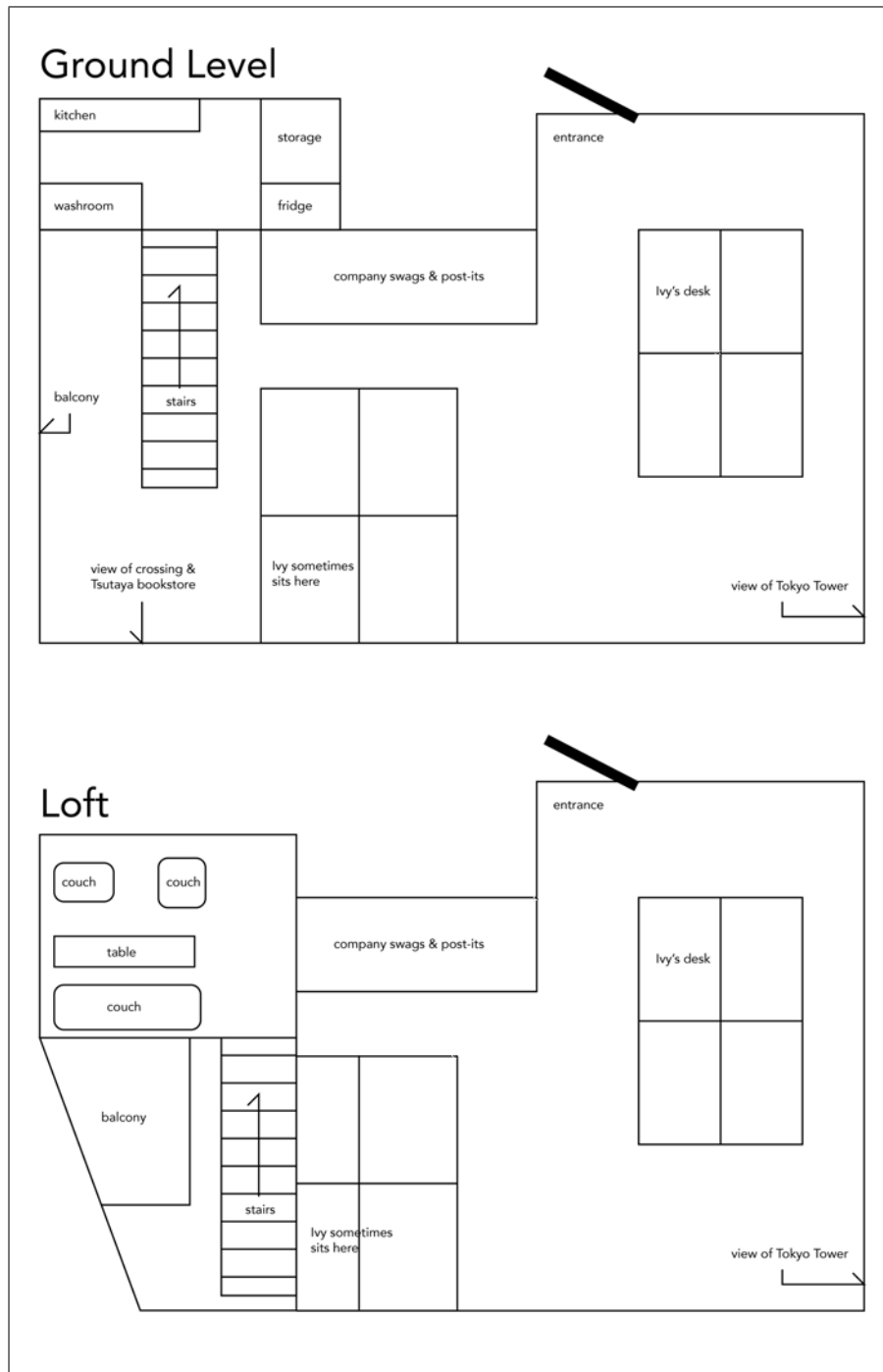


Figure 3.3: Ivy's Physical Model

Mental Model	
Sees schedule	Exercise and feels relieve of stress
Sees not a lot of work	Start the day slow
Sees work to be done	Starts working
Sees no good ideas yet	Feeling stressed
Sees nice weather and walks outside for lunch	Enjoys sunshine and fresh air feel relieve of stress
Eats food	Has good food and feels refreshed after lunch
Sees a cupboard not assembled	Change of work and feels the duty to build it with coworkers
	Discuss on ideas with coworkers
Listens to coworkers talk	Changes environment to quiet space to work
Sees unfinished work	Enjoys change of environment and quiet working space
Walks to second floor	Joins and plays bingo feeling stress free
	Talks about work
Sees coworkers in meeting having fun	Eats and feel energetic
Sees friend	
Eats food	

Figure 3.4: Ivy's Mental Model A

Mental Model			
Sees	Exercise	Taste	Refresh
	Work		Change
	Stress		
	Change		
	Plays		
	Talks		
	Refresh		
Listens	Discuss	Walks	Refresh
	Talk		Change
	Think		

Figure 3.5: Ivy's Mental Model B



Figure 3.6: Suki

Fieldwork Two The second fieldwork was conducted on August 22nd 2016 on Suki Fong, a young female worker from Hong Kong (Figure 3.6). She works at a start up company as a full-time Marketing Executive and lives with her family. This fieldwork was conducted as an interview than observational research. The subject was asked to record one of her usual working days from waking up to the end of her day, then a Skype interview was further conducted.

Throughout Suki's day at work, she listens to a lot of music while working, it keeps her mind relaxed. At lunch time, Suki watched some Japanese drama while eating her lunch, this helps her change her mindset from working to relaxing for her break time. In her afternoon break, she fed the fish and talked to them, then let her mind go blank on the sofa. Suki takes a longer break around every two to three hours, and stretches while working to hep her focus on her work. A flow model was made to analyze the actions and interactions of the interview (Figure 3.8).

A day with Suki Fong

8:30-9:15am	wake up and get prepare for work (include having breakfast)
9:15-10:00am	head to work by MTR and get ready to work
10:00-10:30am	join the sales team meeting (shared the experience of yesterday event)
10:30-12:30noon	listening to Charlie Puth and did the translation for google advertising key word list (poured water and stretched for a few times)
12:30-13:30pm	Lunch time and watched Japanese drama
13:30-15:50pm	was still listening to Jay Chow while working on the translation and ate a pack of Ritz (was bitching the Singapore team with my Korean colleague about the translation work which they assigned and lead time given is only 2 days!!!! Also complaint to my GM how annoying the translation work and how I was fed up with that)
15:50-16:15pm	fed the fish and talked to them, chilled on the sofa and let my brain went blank
16:15-16:30pm	discussed the off-site event in August with colleagues
16:30-18:30pm	Worked on the Chinese page of Chope website and push notification for our app
18:30-19:30pm	Handover meeting with my senior cos she will go on holiday the coming week
19:30-20:00pm	Head home
20:00-22:30pm	Dinner then watched TV and shared my day with my family

Figure 3.7: A Day With Suki

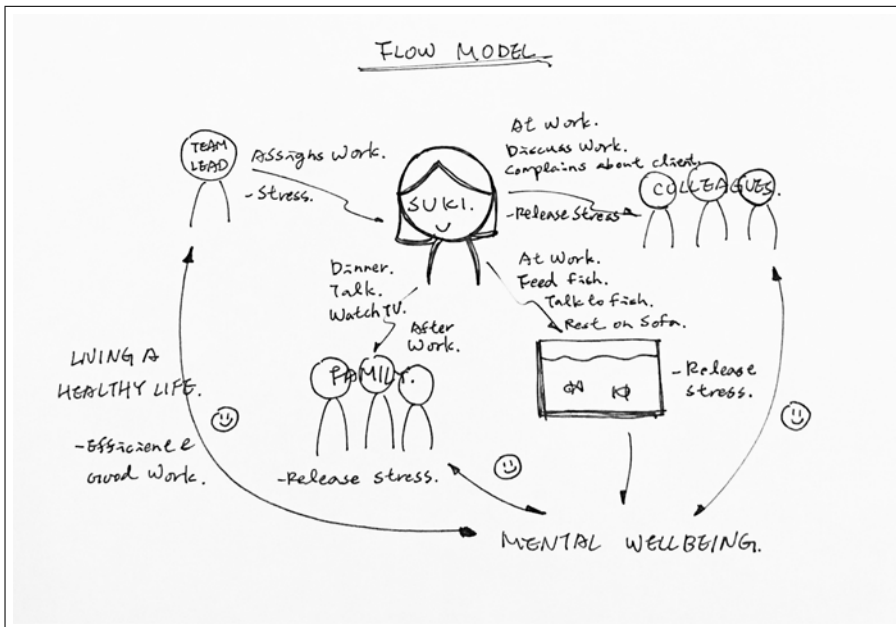


Figure 3.8: Suki's Flow Model

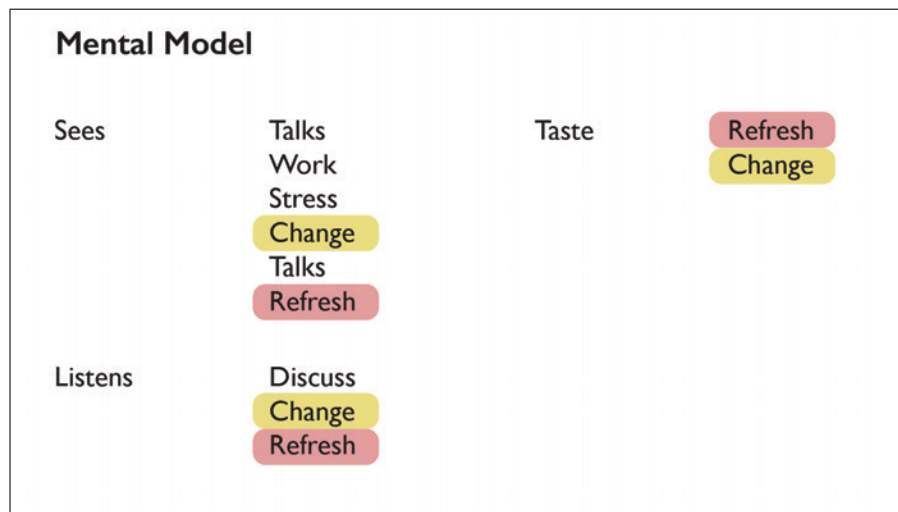


Figure 3.9: Suki's Mental Model

During the interview, Suki mentioned the key words *change*, *focus*, *colleagues*, *music* and *family* several times, the change of environment and interacting with people helps her relax and stay focused at work. Her cognitive behavior was also listed and analyzed as a mental model (Figure 3.9).

Summary From the analysis of the observation research and interviews conducted on potential users, some insights are summarized, including the following:

- When encountering stress at work, clearing all thoughts helps relief the stress.
- Changing environments or activities helps clear the mind and refocus on work.
- All actions pursued when interacting stress leads to refresh, change and refocus.
- Physical exercise and social relationships help in reducing stress.

After the two fieldwork research, a target persona was developed, then the design thinking process continued on to ideation. The next part of the observation research was done after deciding on a concept.

3.2.2 Understanding Meditation Practitioners



Figure 3.10: During Breathing Meditation Exercise

Fieldwork The final concept was decided through the design thinking process, however, to further understand the actions of breathing meditation, observation research and interview was also conducted on a regular breathing meditation practitioner. Ghufon Yazid, a thesis student from Indonesia, born and raised in Japan, was the subject of this fieldwork.

Breathing meditation is applied whenever he feels stress or anxious. The first step is to find a quiet environment and sit in a comfortable position to start the process. Second, is to focus on breathing itself, pay attention to breath in then breath out, breathing motions slows down. Third, is to keep steady deep breaths until feeling relaxed and has cleared the mind. The whole process took about one minute.

Before the observation, Ghufon was not feeling particularly stressed, therefore, it only took around one minute for him to calm his breathing. He suggests that due to different conditions, the speed of breathing is completely different and takes different amount of time to calm the speed of breathing and complete breathing meditation.

Summary After the observation research, the understanding of breathing meditation are summarized as the following:

- Takes only a short time to complete breathing meditation exercise. Around one to five minutes.
- Focusing on breathing itself helps clear the mind, then relax.

The insights of the observation research will be used in designing *LULL*.

3.2.3 Target Persona

From the observation research conducted above on understanding users, a *target persona* was created to represent a target user group. Abby Wong, age 26, a young female who works as a UI Designer in Tokyo, she enjoys her job and aims for perfection at work, sometimes have to work extra hours to achieve the high standards she sets for herself.

Abby puts on herself under a lot of stress at work to achieve perfection, sometimes it is a bit overwhelming for her, and she finds it difficult to manage her stress. Recently, she just moved to Tokyo, and has to adapt to a new environment and new job, therefore, she is finding it more difficult than usual to relax. Abby's stress is slowly turning into chronicle stress and needs a solution for her to change her state of mind. Abby's detailed profile is explained in Figure 3.11.

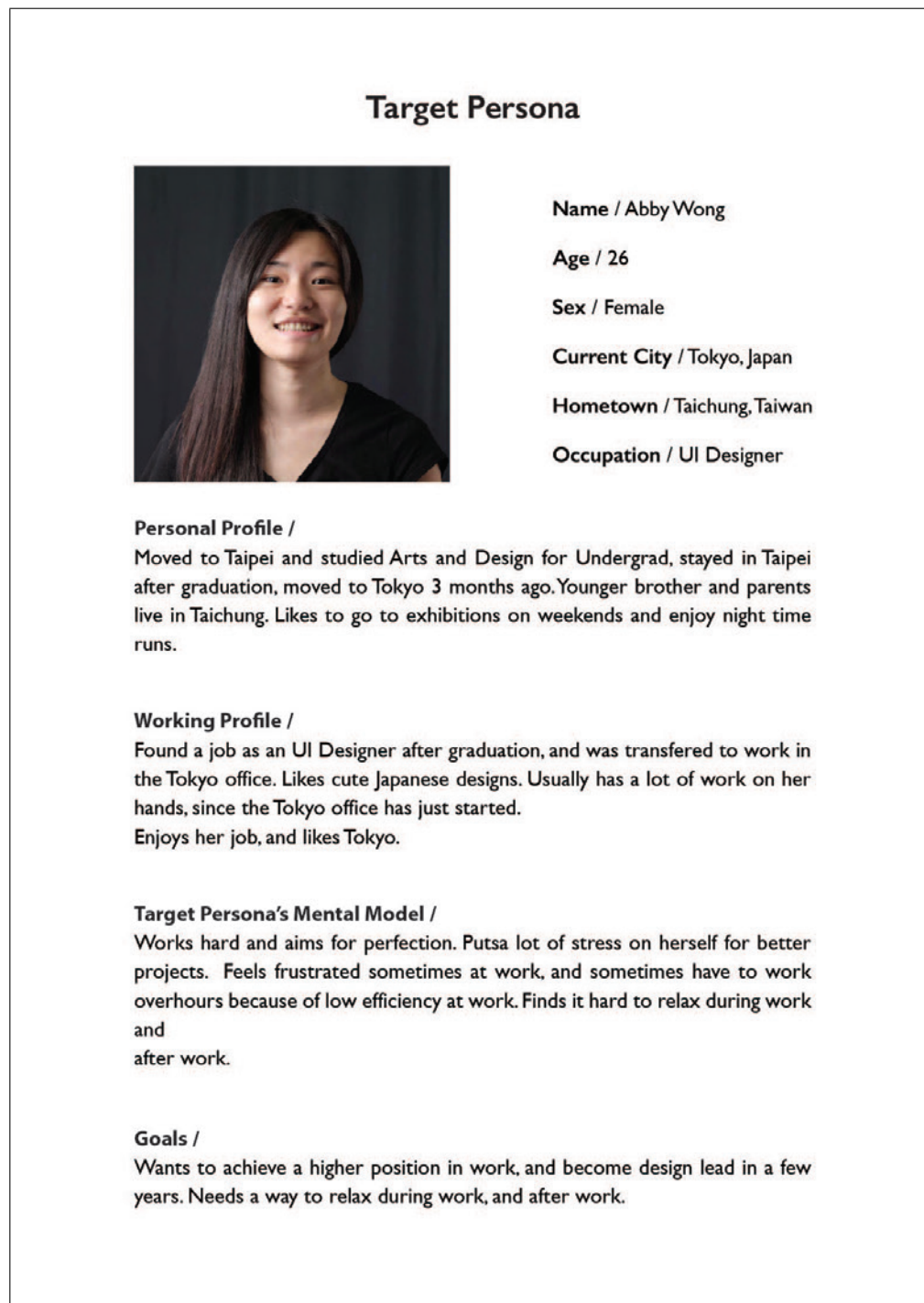


Figure 3.11: Target Persona



Figure 3.13: Brainstorming 2

3.3.2 Concept Sketching

After the brainstorming process, concept sketches were made. The brainstorming ideas were combined into two concept sketches. For Concept Sketch 1, users own a digital pet that provides a short break for the mind. By interacting with the digital pet, the pet guides users through a short session of breathing exercise. For Concept Sketch 2, the idea is for users to own a digital pet that acts as an alert for the users to exercise. The pet acts as a reflection and prediction of the user's health status.

It was considered to combine both concepts into one at this stage of the design process, however, to have a specific focus and goal for the project, Concept 2 was let go. The final concept was decided to combine Deep Breathing Meditation training with gaming experience, to offer a short break for the mind.

3.3.3 Rough Prototyping

By making a rough prototype, the concept made in the previous ideation stage was tested. A simple animation was made to simply test the concept if the users would follow the character to breath in and breath out. The results were promising, the user would breath along with the characters if instructed to, however felt boring and would like more interaction and connection with the character.

After briefly testing the concept, more research was done to further understand breathing meditation. Fieldwork was conducted on a regular meditation practitioner, refer to Chapter 3.2.2 for details.

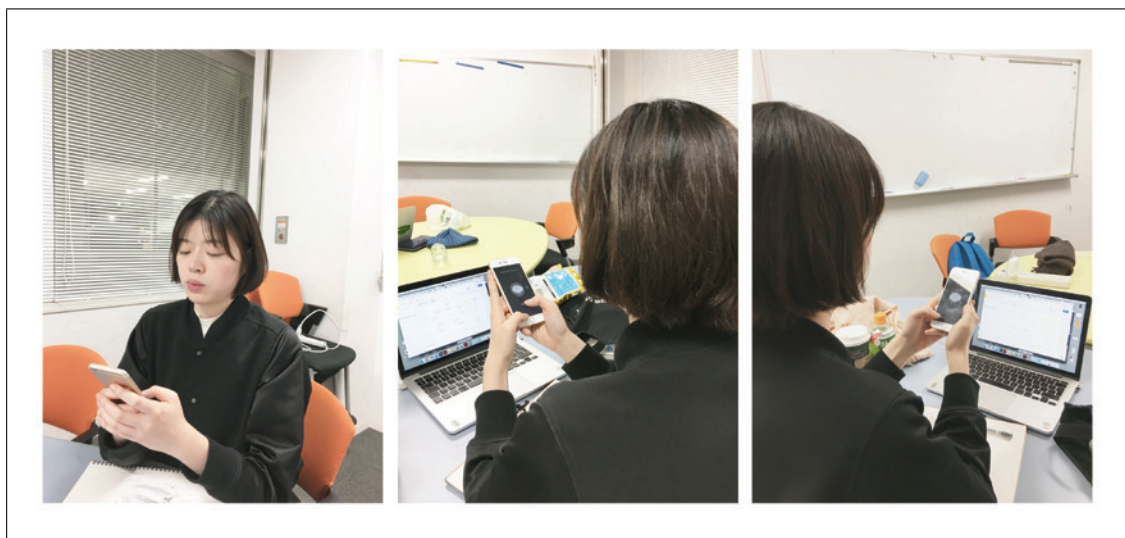


Figure 3.16: Rough Prototype Testing

3.4 Game Design

Acknowledged in previous research, "MDA: A Formal Approach to Game Design and Game Research", the approaches to designing a game includes Mechanics, Dynamics, and Aesthetics. Aesthetics represents the emotions the players experience through the game and through understanding these emotions, it acts as a compass to a better design in the experience of the game. Dynamics seek out to create the aesthetics experience, by identifying feedback systems in this stage can help build a solid ground to build the experience of the game. Mechanics are the controls and behaviors of the game that support the gameplay dynamics. The

MDA formula will be used as a reference to the design process of *LULL*. Further details of designing a game will be discussed.¹

Based on the final concept developed from the ideation process, *LULL* was designed. The basic story of *LULL* is that in the wonderful element world of *LULL*, Darkness takes over elements to gain energy. The user has to help the characters defeat Darkness.

3.4.1 User Experience

A user experience flow was designed at the very start of the developing process. Using the MDA formula to design a game, aesthetics and dynamics were considered during the making of an user experience flow. (Figure 3.17)

After designing the user experience throughout the game, a user interface flow was then designed, considering the M for mechanics in the MDA formula. Users start on a relaxing starting page, that gives users a brief image of what type of game *LULL* is, and creates a soothing environment. Then users access the more complicated characters page, then guided to different gameplays. After the gameplay, the users are guided back to the starting page. *LULL* targets to make the user experience as simple as possible, to create as little stress as necessary. (Figure 3.18)

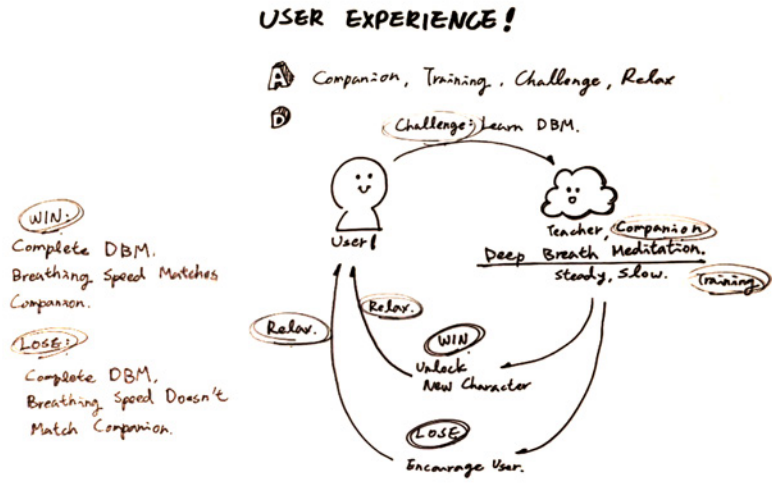


Figure 3.17: User Experience Flow

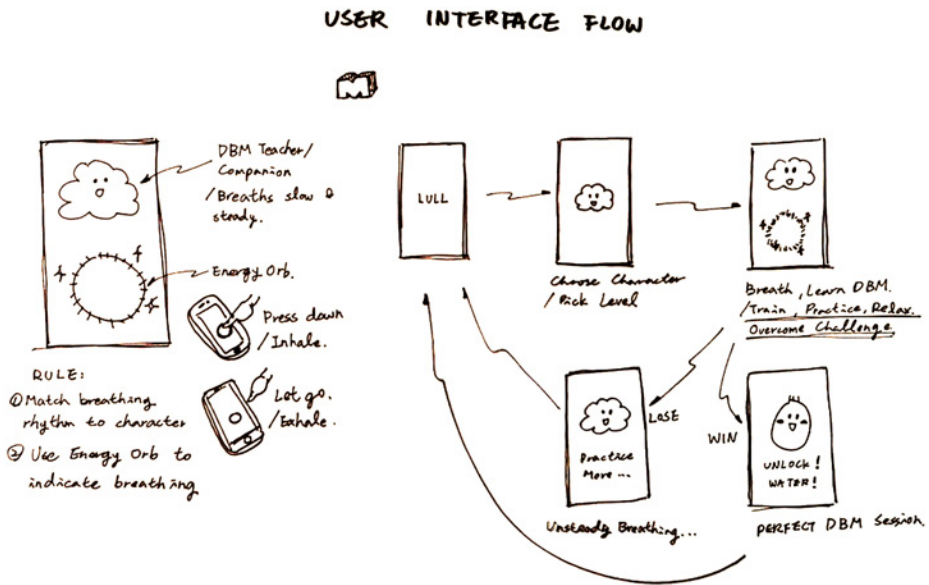


Figure 3.18: User Interface Flow

3.4.2 Characters

Characters are designed based on the background story built around *LULL*, a world of wonderful elements. The first three characters designed were cloud, fire, and water.

Since the characters act as a very important part of the game, it builds empathy and need to connect with the players, therefore, after designing the first version of the three characters, potential users feedback was taken into account on the designs. The first version was built in 3D, and rendered in a cartoon 2D style, to give the game world more potential in further developing process. However, some feedback were that big eyes are scary, characters dont match each other, theyre staring into my soul. (Figure 3.19)

The 3D characters werent that popular. Therefore, a second version was developed, as shown in Figure 3.20. Starting from the second version, all characters were designed in 2D forms.

In the second version, feedback was taken into consider after designed as well. Each potential users has a different taste and preference for the characters, mostly, characters with smaller eyes are more popular, most problems users had were that they still couldnt find a character they prefer and can connect to over time. Therefore, a third and final version was designed.

A total of ten characters were finalized and developed for *LULL*. Each one representing a natural element, an animal, or a plant. A brief background story was also designed for each character to build empathy with the users. (Figure 3.21)

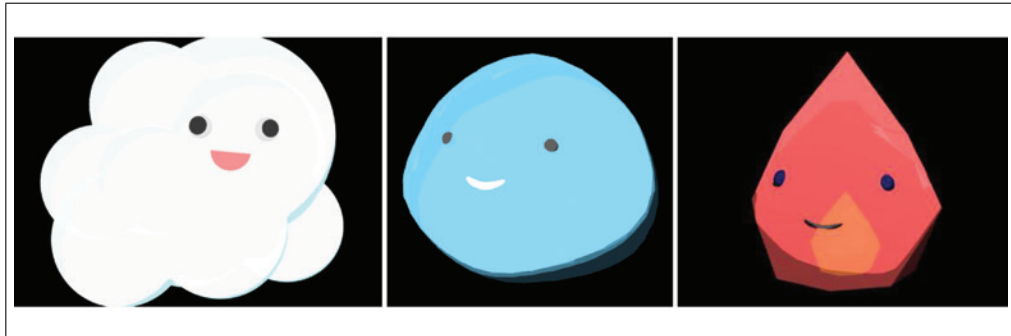


Figure 3.19: Character Design: Version 1

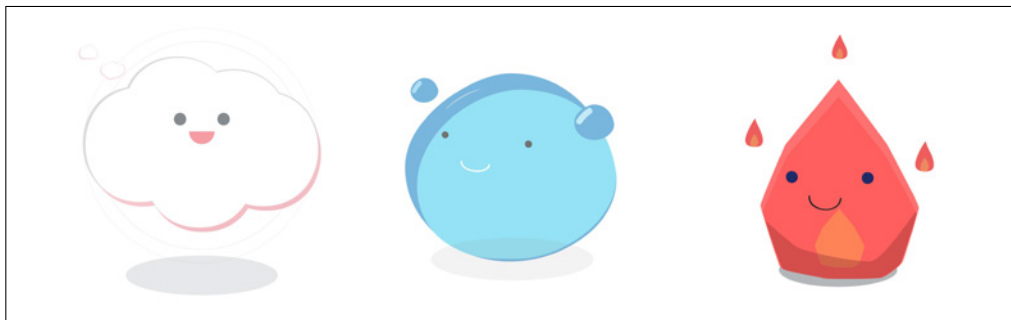


Figure 3.20: Character Design: Version 2



Figure 3.21: Character Design: Version 3

For each character, a brief background story and characteristic was designed. From left to right in "Character Design: Version 3" are Wee, Esta Egg, Mei, Sunny, Emo, Red, Blob, Puff Master, Jello, Left and Right. Wee is a weed grass that grows in the desert. Esta Egg likes onsens and has nice smooth skin. Mei is a sheep that likes being covered in snow. Sunny is bright and energetic and likes hugs. Emo is shy and loves to play hide and seek. Red lives in a fireplace and warms peoples hearts. Blob is a water drop that changes his shape as he please. Puff Master floats and fly. Jello like to be the center of attention. Left and Right are twins that doesnt like to be separated.

3.4.3 Game World

After the character design was settled, a game world needs to be designed. Creating a game world for users to feel comfortable and stress-free during the gameplay is important, since *LULL* is designed to serve as a game to improve mental well-being. Figure 3.22 indicates the background story of *LULL*.

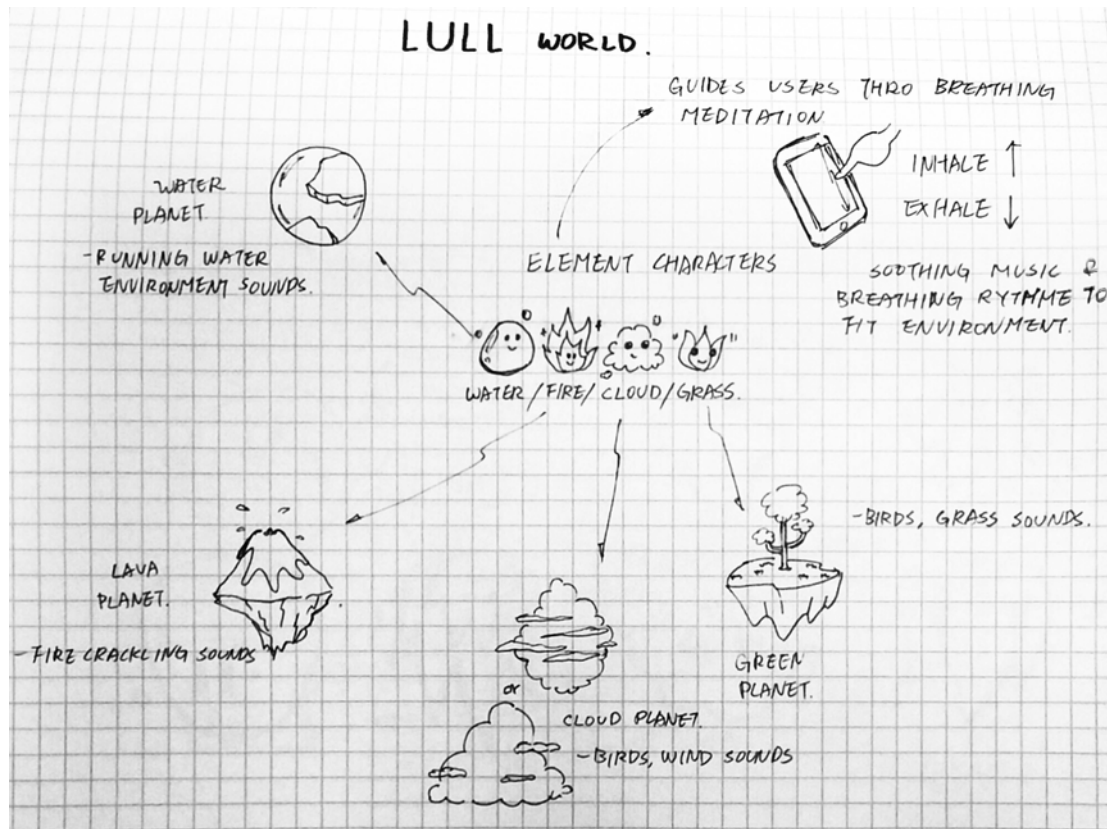


Figure 3.22: Game Story

LULL is a world of wonderful elements, each and every character has their designed planet, which serves as their habitat. Darkness has taken over their planets and it is up to the players to help save them.

The game starts in the *LULL* universe, an abstract of the sky and land, a calming gradient of cool sky blue and warm brown (Figure 3.23). Each character is designed to have their own planet, a habitat that serves their personality and design. Each character stands for a new level that users unlock if achieving the

ultimate win. In Figure 3.23, all the characters are already unlocked. Further gameplay experience and the *ultimate win* status will be further discussed in the next section.

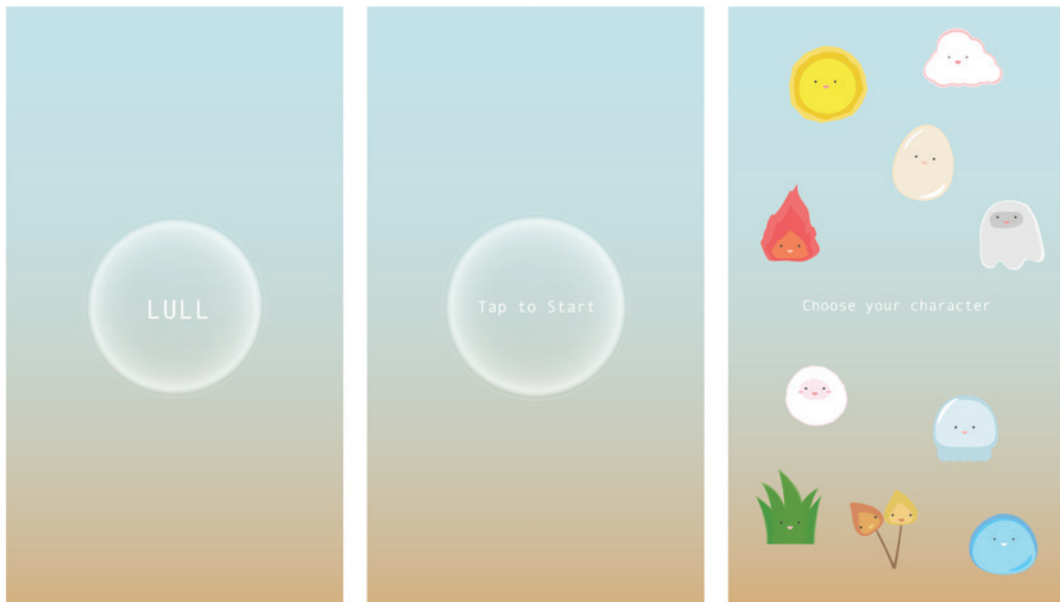


Figure 3.23: Game World

For the working prototype, two levels were designed and completed: a) Puff Master and b) Esta Egg, as shown in Figure 3.24. Puff Master's planet was designed to be a warm, pink and fluffy environment, it is also the first level of the game, which gives a soft soothing vibe to the user. Esta Egg's planet was designed to fit his character, in an onsen. The colors for Esta Egg's environment are more neutral and calm. It is also a more difficult level for the players, detailed movements in the environment was also designed to keep the player's attention.



Figure 3.24: Game World: Level a) Puff Master b) Esta Egg

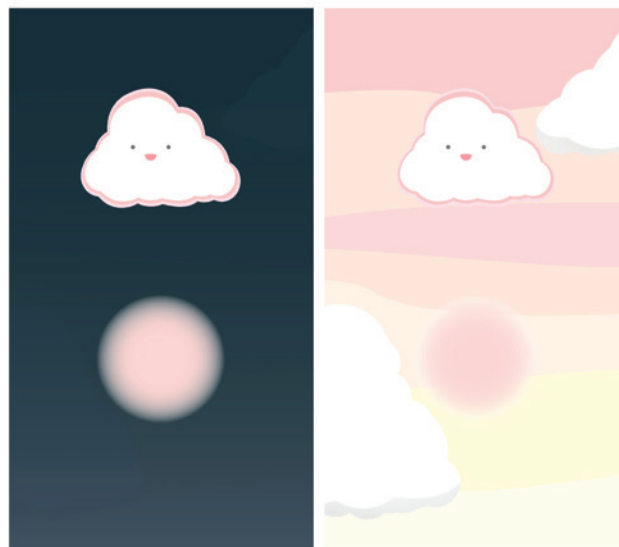


Figure 3.25: Game World: Darkness

Darkness is the villain of the game, it represents stress, depression and anxiety, it is designed to have an abstract form. In the gameplay, Darkness has invaded the *LULL* world, and will appear at the beginning of each level, then slowly fade away during the gameplay, as indicated in Figure 3.25. The gameplay and rules will be explained in the following chapter.

3.4.4 Gameplay

The first time opening the App, a simple tutorial will activate to guide users to breath along with the characters, and teach players how to monitor the game. (Figure 3.26)



Figure 3.26: Tutorial

Throughout the tutorial, the player will learn the rules of the game:

1. Adjust the players breathing to match character's breathing. In the tutorial, they have to match Puff Master's breathing. Slow and steady.
2. Second step, is for players to learn to use the control of the game. Touch the energy orb to indicate the player breathing in, and let go of the orb when breathing out.
3. The rule of the game is simple, players have to focus on matching their breathing and the rhythm of the scaling of the energy orb to match Puff Masters breathing. After the tutorial, users enter the usual gameplay mode, the first level they encounter is Puff Master.

Puff Master is the first level to the game, it is designed for users who is new to Deep Breathing Meditation or has no experience with any breathing exercises. Users will only be allowed to choose Puff Master at the beginning of the game.

After the tutorial, users enter the usual gameplay mode.

The gameplay of a level (LV.1 Puff Master) is shown in Figure 3.27. In each session, the game starts covered in Darkness, the player uses DBM to gather energy for the character to help defeat Darkness. The bar on top indicates how long the DBM session is left. The player is expected to adjust their breathing at the beginning of the game, then slowly match their breathing rhythm to the character over time. The simple finger movement helps users focus on their breathing as well, by holding down when breathing in, and letting go when breathing out. Darkness will then slowly fade throughout the gameplay. After each game, the *Home* button guides users back to the starting page of *LULL*. The reward system of the game will further be discussed in the next chapter.

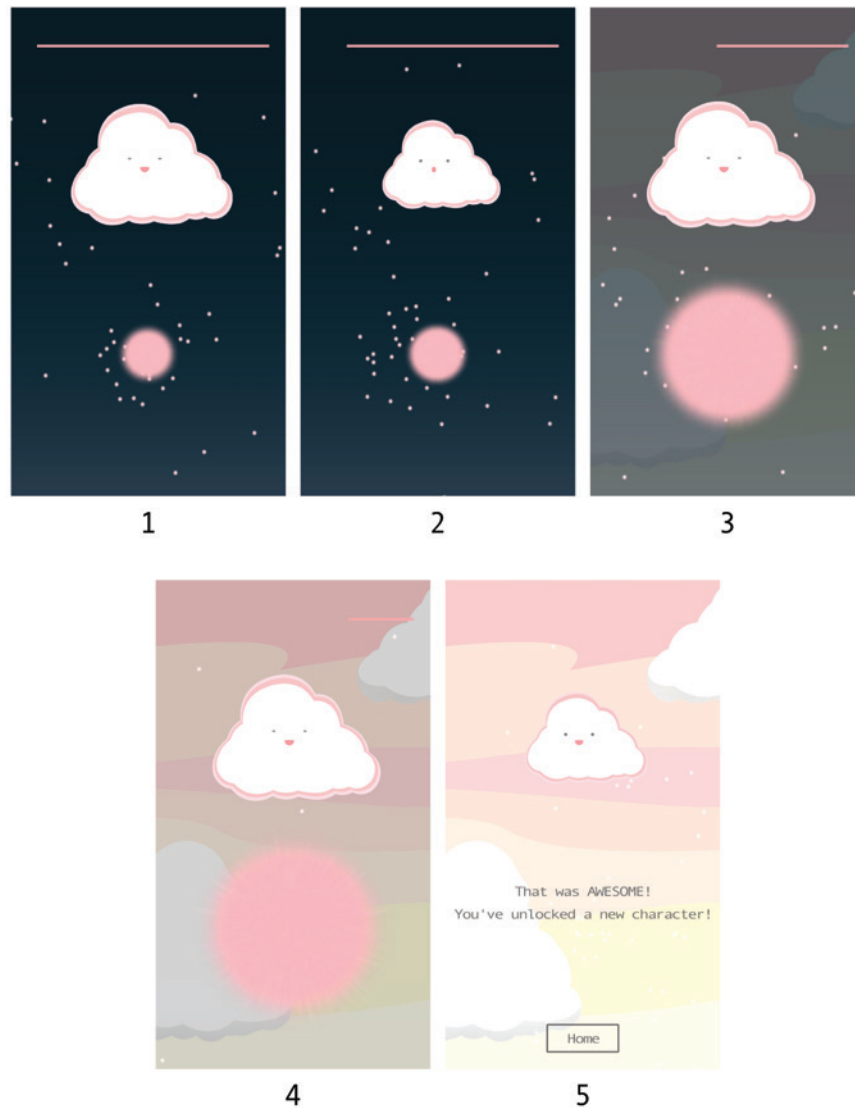


Figure 3.27: Gameplay

There are different difficulty levels designed for the game, *Difficulty 1* is the easiest, each breath takes four seconds to inhale and four seconds to exhale, which should slow the users respiration rate to 7.5 breaths per minute. For each level, each breath adds half to one second longer to breath in and breath out, the breathing speed gets even slower according to the difficulty levels. The most difficult level currently developed is *Difficulty 4* which takes six seconds to breath

in then six seconds to breath out, which will slow players' respiration rate to 5 bpm in the end.

Users can choose different characters due to their preferred breathing speed and favorite character. The more users practice DBM, the more they will get used to more difficult levels. According to different situations, users can choose different characters as well. For instance, users can choose a *Difficulty 1* character before a stressful presentation, or competition, the short gameplay and breathing speed is suitable for a quick relax in stressful conditions. *Difficulty 4* characters are more suitable for quite, private meditation sessions when players have more time and are not disturbed by other factors.

3.4.5 Game Reward System

There are two key rewards designed in the gaming experience:

- Unlocking new characters.
- Keeping the characters active.

Players go through the challenge of following and completing DBM sessions in order to acquire these rewards. By matching their breathing rhythm to the character perfectly in the one to five minutes sessions unlocks a new character. Continuously practicing DBM everyday keeps the characters active, characters will start to fade one by one from the most difficult level and down for over 24 hours without using *LULL*. Players will have to unlock them again by performing perfect DBM sessions.

The ultimate goal of *LULL* is to improve users mental well-being, therefore, to maintain the users in a relaxed gaming environment, there are no *losing* status designed in the game, whether the user achieves a perfect session of meditation or not, the game will only provide a *win* and *ultimate win* difference. The *win* status happens whenever the user finishes a session of gameplay and defeats Darkness, and keeps the characters active. The *ultimate win* status is activated whenever the user achieves matching the rhythm perfectly to the character within the whole DBM session. Achieving the *ultimate win* means a perfect meditation session, and proves that they can move onto the next level, which enables users to unlock the next new character for them to collect and meditate along. Users unlock characters according to the difficulty levels. Difficulty 1 characters are unlocked first, then Difficulty 2, 3, then 4.

Another hidden *reward* is the benefits of practicing DBM, relax, refocus and recenter. Users will learn about DBM and train naturally with the characters while playing the game, this is the final outcome *LULL* aims to achieve. Over time, *LULL* can become a go-to solution when players experience stress, which will further improve their mental well-being.

3.5 Prototyping Process

Building a working prototype of *LULL* can be discussed in two main phases (1) program structure and (2) implementation.

3.5.1 Program Structure

The game is built and programmed in Unity ² using the coding language C# to maintain it's future potential development on other platforms. Animation was first designed and adjusted in detail to stimulate breathing motions. As mentioned earlier in Chapter 3.2, breathing meditation observation research was done on usual practitioners, and the animations were built based on the observations.

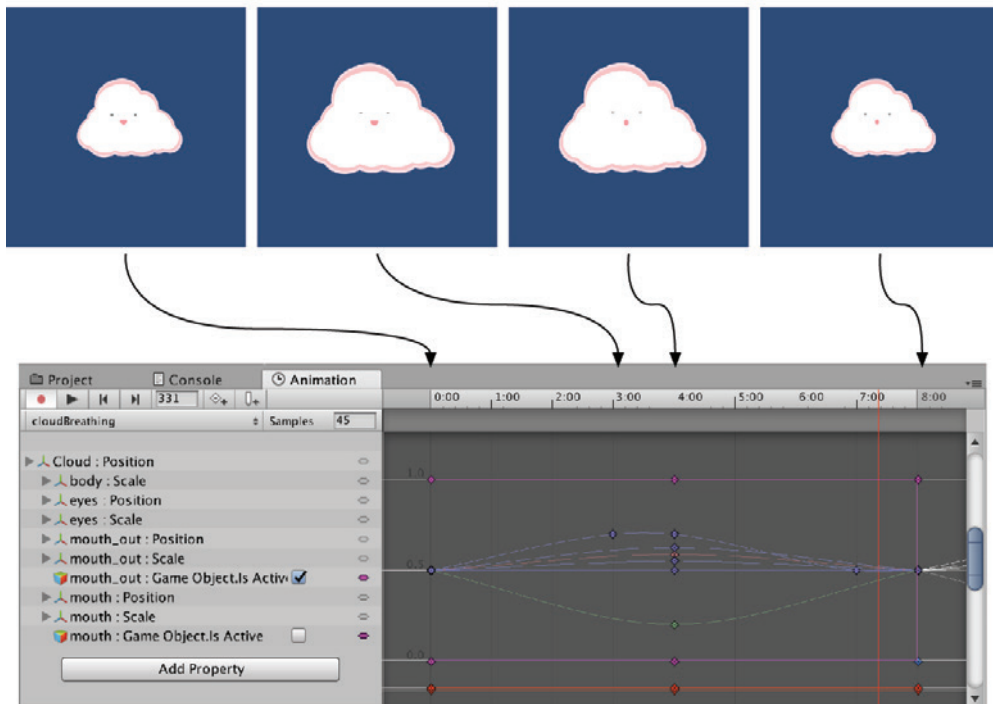


Figure 3.28: Puff Master's Breathing Animation

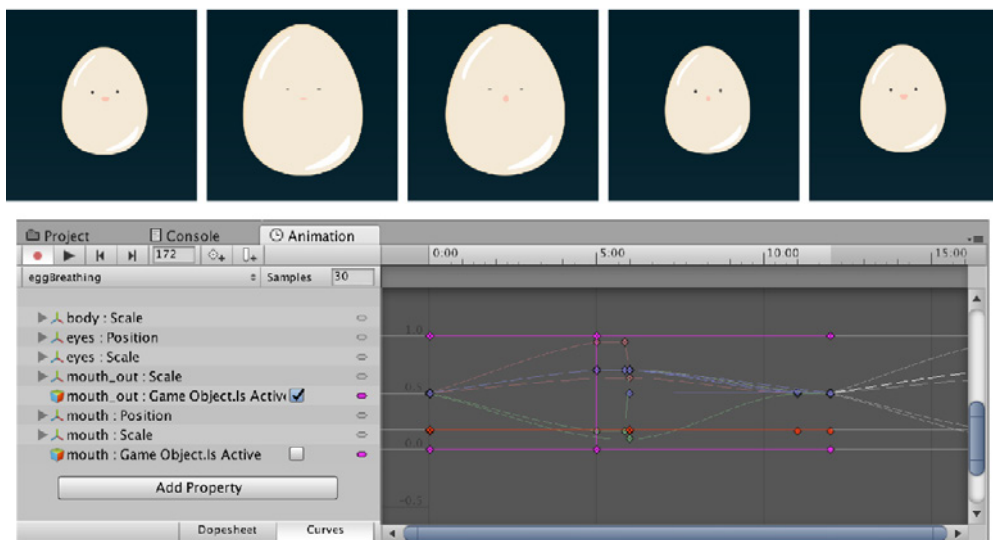


Figure 3.29: Esta Egg's Breathing Animation

The control button was further developed. In research done in previous chapters, while practicing breathing meditation, new energy is absorbed into the body while breathing in, then tension and stress is let go from the body while breathing out. A simple control button was designed for users to easier understand that process. The control is the shape of a ball of energy, a particle system was also designed to interact with the simple finger movement, to help users understand and focus on how they are breathing. While breathing in, gathering new energy, the particle system moves inwards, then breathing out, letting go of old energy, the particles moves outwards. The speed of the control is adjusted according to different levels, for users to easily match the breathing rhythm.

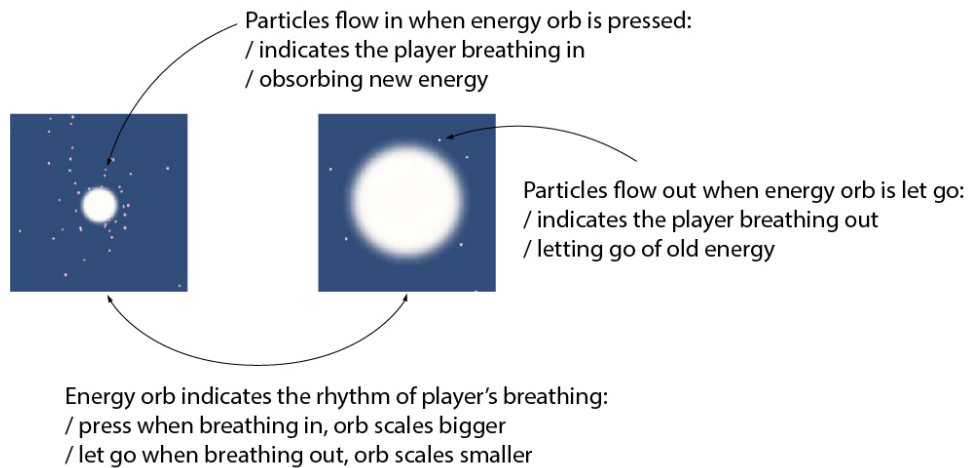


Figure 3.30: Control Orb

In order to define whether the user unlocks the next character or not, a *point system* was coded to calculate the amount of breaths that matched the character's breathing speed. However, the system is hidden and will not show the points throughout the gameplay, since *LULL* is designed to create as little stress as possible for the users. Different scenes were developed in the program structure for the users to unlock due to the *point system*.

```
30 // Update is called once per frame
31 void Update () {
32
33     totalElapsedTime += Time.deltaTime;
34     elapsedTime += Time.deltaTime;
35
36     if (elapsedTime > breathSpeed) {
37
38         if (inhale) { //close to scale 9
39             if (Orb.transform.localScale.x > 2.5) {
40                 score++;
41                 Debug.Log ("point+ ");
42             }
43         }
44         else { //close to scale 5
45             if (Orb.transform.localScale.x < 1.5) {
46                 score++;
47                 Debug.Log ("point+ ");
48             }
49         }
50     }
51
52     inhale = !inhale; //invert inhale exhale
53     elapsedTime = 0; //reset 3 sec
54 }
55
56
57
58 // one minutes passed, win or lose
59 if (totalElapsedTime >= gameTime) {
60
61     //win
62     if (score >= winScore) {
63
64         WinText.SetActive (true);
65
66     } else { //lose
67
68         LoseText.SetActive (true);
69
70     }
71
72     Orb.SetActive (false);
73     gameObject.SetActive (false);

```

Figure 3.31: Code for Point System

3.5.2 Implementation

LULL is designed as an App game to run on a smart-phone device. Unity is a software designed to export games and codes for several different platforms, therefore, *LULL* can be converted into iOS system or Android. However, the iOS version is first developed for the working prototype.

Two levels were completely developed for the working prototype, a *Difficulty 1* level, Puff Master, and a *Difficulty 4* level, Esta Egg.

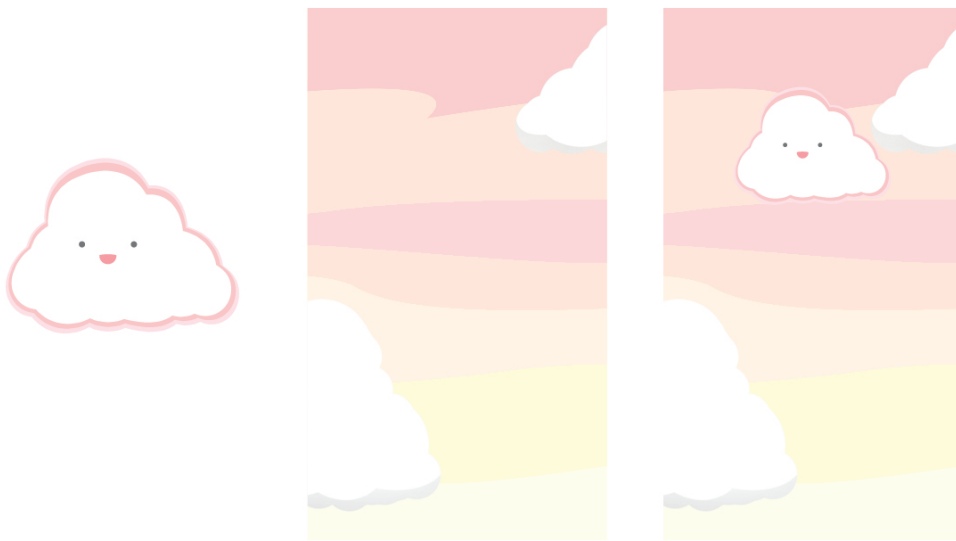


Figure 3.32: Level: Puff Master

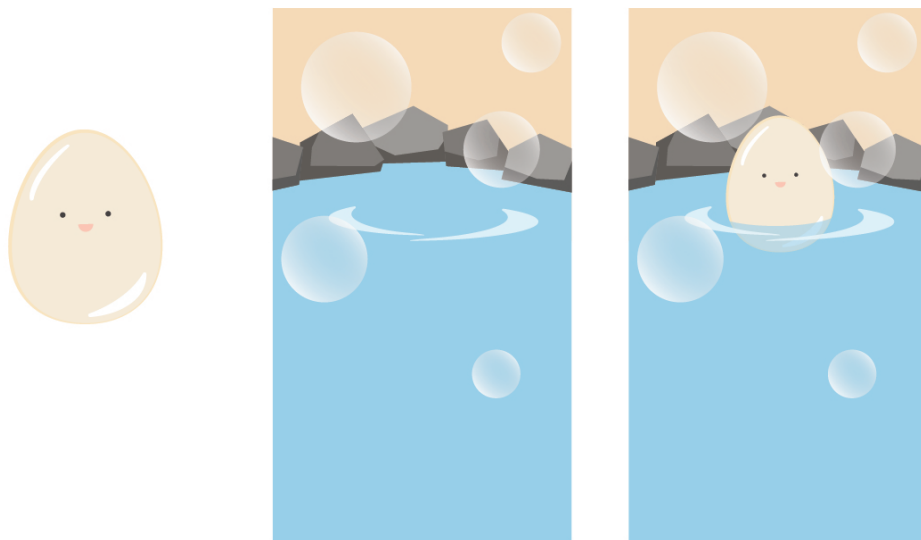


Figure 3.33: Level: Esta Egg

Puff Master was designed for beginners who has never practiced breathing meditation, or users whose breathing speed is slightly faster. Esta Egg, on the other hand, is designed in a much slower speed, for yoga and mindfulness practitioners.

The prototype is brought to 5 different users for testing of concept. Further testing results will be discussed in Chapter 4.

3.6 Design Summary

In this chapter, the concept of *LULL* was first defined, then ethnography research was discussed to understand target users, ideation and rough prototyping was then conducted, at last the detailed design and working prototype was developed between back and forth reviews from potential users.

To summarize, *LULL* is a game that aims to improve users' mental well-being through providing a short break for the mind by going through a session of Deep Breathing Meditation.

- Users can easily clear their mind, reduce stress, then refocus and recenter again.
- Through the gameplay, it is relaxing, interactive and interesting to practice Deep Breathing Meditation.
- Playing the game can educate users on DBM, and become a go-to solution when users are in stressful conditions.

The evaluation results of the working prototype for *LULL* will be discussed in the next chapter.

Notes

- 1 Hunicke, Robin and Leblanc, Marc and Zubek, Robert. A Formal Approach to Game Design and Game Research(Hunicke et al. 2199)
- 2 Unity, <https://unity3d.com/>

Chapter 4

Evaluation

LULL is a smart phone app game for young busy adults to access anywhere, anytime, when in stressful conditions. By guiding them to do Deep Breathing Meditation through gaming experience, it helps reduce stress and acts as a short break for the mind. *LULL* aims to help users clear their mind, relax and refocus in a short session of time, hence improve their mental well-being. *LULL* approaches the goal of this research through (1) guiding the player through Deep Breathing Meditation exercises with cute characters, (2) overcoming DBM challenges unlock new characters motivates the user to continue the game, (3) helps users reduce stress through conducting DBM. A final working prototype was developed to test the feasibility with the above focus points.

The evaluation method will be first defined. Results will list in detail the evaluation of each individual participant. Discussion will then be analyzed as validation and proof of concept.

4.1 Evaluation Method

Evaluation was conducted with the working prototype created as mentioned in the previous chapter. The prototype has two completed levels of the game, for users to activate and play on their own. A pre-game interview will be conducted to understand the participant's (1) socio-demographics, (2) previous experiences in Deep Breathing Meditation, and (3) self-reported stress levels. Then the prototype will be presented to the participant on an iPhone 6s platform, observation research will then be conducted for the in-game process. Last, a post-game interview will be conducted to understand (1) game experience, and (2) self-reported stress-levels.

The final prototype has a tutorial and two complete levels of different difficulty level for evaluation, *Puff Master* and *Esta Egg*. Puff Master is the first level of the game, and completing level 1 unlocks the next level (Esta Egg). It is implemented

in an iPhone 6s¹, and brought up to the participants. Participants will be asked to experience both levels.

Through the evaluation process, this research aims to validate: (1) *LULL* guides and educates users through Deep Breathing Meditation exercises in a relaxing and engaging way, (2) *LULL* helps in stress reduction and improves mental well-being.

4.2 Results



Figure 4.1: Interviewee 1

Interview One

Pre-game The first interview was done on a graduating Master’s student, male, 25 years old (Figure 4.1). During the pre-game interview, he mentioned regularly practicing breathing meditation exercises, therefore, he was already familiar with the benefits of breathing meditation and understands how to conduct breathing meditation to help himself relax. The subject’s current stress comes from mostly writing his thesis and his part-time job, the self-reported stress-level before the gameplay was slightly stressed but not feeling uncomfortable.

In-game Considering the participant's performance in the game, he completed the first level smoothly after spending 30 seconds to adjust to the respiration rate of the character. In the second level, the respiration rate was too slow for him, he still completed the stage, however, did not match his breathing with the scaling rhythm of the energy orb. The gameplay did not take the participant much effort to master, after the tutorial, he could control his breathing to match the character, then initiate the control of the energy orb along with his breathing. In the game experience observed, the participant smoothly followed the designed flow of the game, and can access designed events without problems. A small problem considering designed interfaces was that the participant tried to access other characters the first time activating the character page.

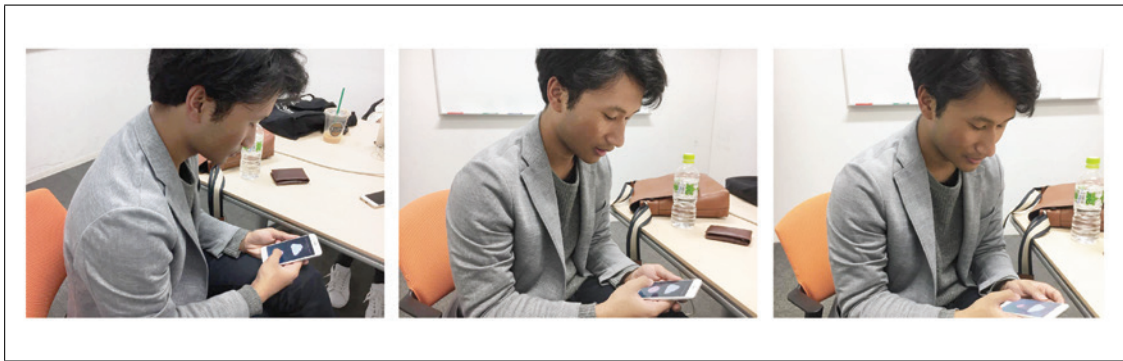


Figure 4.2: Participant 1 In-game

Post-game In terms of game experience, the participant self-reported the game was relaxing, and the characters are cute and interesting to watch. However, he would like to interact more with the cute characters, other than only conducting DBM training with them. Considering self satisfaction, he likes the design of defeating Darkness, thinks the energy orb control is engaging and seeing the change in the environment helps him relax. The participant reported stress reduction after the game, and learned to conduct DBM along with the cute characters.



Figure 4.3: Interviewee 2

Interview Two

Pre-game The second interview was conducted on a female, first year Master's student, age 27 (Figure 4.3). She has no experience in meditation or mindfulness, and she does not practice yoga, however, she used to practice breathing exercises to play instruments that require long breathing techniques, she understands the benefits of breathing meditation that includes keeping calm and boost metabolism. Her stress comes from homework and unfinished projects. When the interview took place, she had a final presentation the very next day for an intense course she was taking, she reported high stress levels before the game.

In-game Game performance wise, the participant was able to accomplish both levels smoothly. Gameplay wise, she spent more time than others learning how to control the energy orb to match her breathing. Considering game experience, she could monitor through the flow and activate events successfully and smoothly.



Figure 4.4: Participant 2 In-game

Post-game In the post-game interview, the participant reported game experience was relaxing, engaging and interesting, thinks the slower respiration rate level is more relaxing for her. Similar to participant one, she would like to interact with the characters in other ways other than only practicing DBM. Self-satisfaction wise, she also likes the flow of the game, it is simple and easy to follow the rhythmic breathing, she also reported the designs was relaxing and soothing, which helps her relax as well. She reported effectively feeling the reduce of stress, and felt relaxed after the game.



Figure 4.5: Interviewee 3

Interview Three

Pre-game Interviewee three is a 25 year old female, working as a full-time designer in a design studio in Tokyo (Figure 4.5). She has had a few yoga and meditation sessions in her previous companies, but has never done it regularly, only when another person invites her to accompany them. She understands that breathing meditation can keep her state of mind calm. Her stress comes from work and having to go to social events. She reported not experiencing any particular stress at the time before the interview.

In-game Game performance wise, the participant was able to accomplish the first level after adjusting, the second level's breathing speed was too slow for her, same as participant one, she stopped matching her breathing speed, but still controlled the energy orb to complete the level. Considering gameplay, the first level's respiration rate was already a lot slower than her usual breathing speed, therefore she spent more effort adjusting her posture and breath to follow along. Considering game experience, she could monitor through the designed user experience flow and activate events without problems.

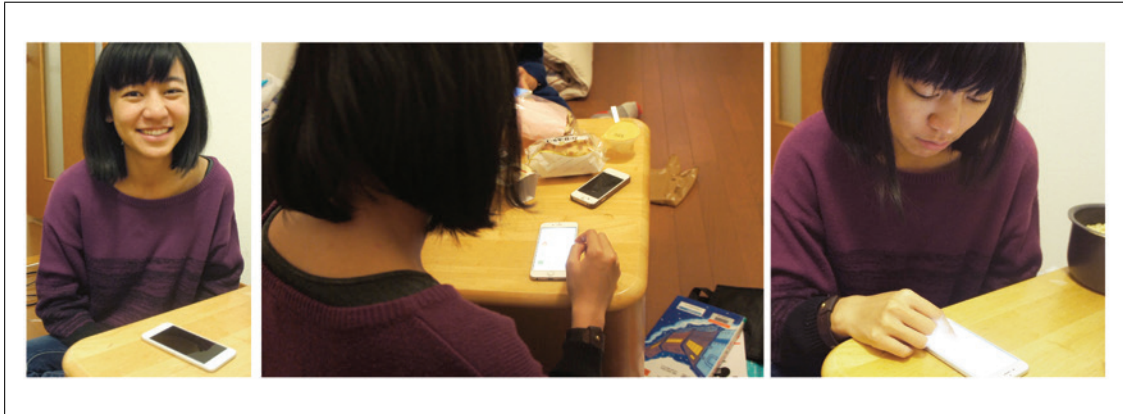


Figure 4.6: Participant 3 In-game

Post-game The participant self-reported game experience was relaxing and calming, she would not practice DBM without the game, however, with the game, she is willing to try. She suggests that it is suitable to play on the train ride to work, however, it might be hard to use on a full train if users had to look at the screen, it might be better if there is a device designed for users when they cannot see the screen. Considering self-satisfaction, she thinks the game is easy to master after one or two tries. She did not experience any specific stress reduction, but felt calmer than before the game.

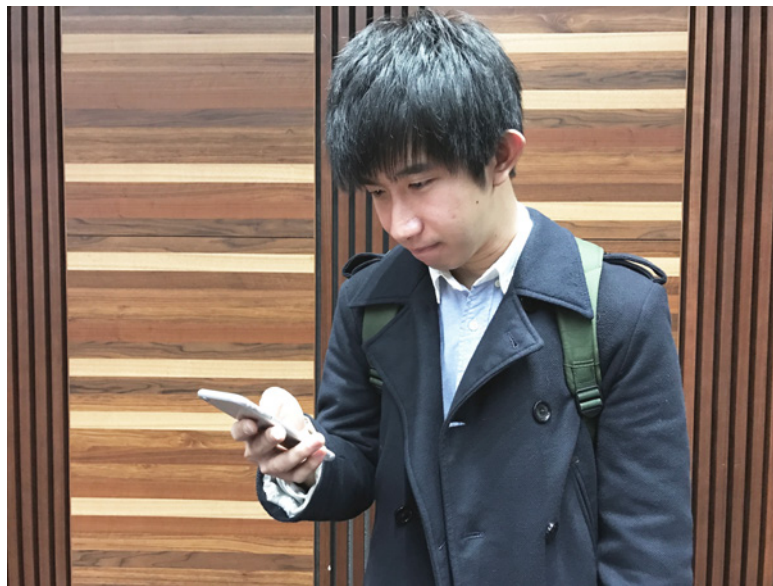


Figure 4.7: Interviewee 4

Interview Four

Pre-game The fourth interview was conducted on a 28 year old male, full-time designer, working in a design company in Tokyo (Figure 4.7). He has no experience in yoga, meditation or mindfulness, and does not understand the benefits of deep breathing exercise. His stress currently comes from his work and clients. The interview was conducted during the weekend, therefore, he was not experiencing any specific stress at that moment.

In-game The subject's game performance wise, he accomplished the tutorial, and smoothly completed the first level. In the second level, as previous participants, could not match his breathing, but maintained controlling the energy orb to complete the level. Gameplay wise, he spent half a minute adjusting his breathing and mastering the energy control orb. Considering game experience, he could monitor through the designed user experience flow and activate events without problems.



Figure 4.8: Participant 4 In-game

Post-Game In the post-game interview, he expressed that game experience was well designed, the characters are very cute and relaxing, and collecting them is fun and engaging. He suggests that the game can be more interactive and interesting, other than only breathing along with the characters. Self satisfaction wise, he feels that it is easy to learn to adjust his breathing after trying one or two times, and that he really focused on his breathing through the gameplay. The participant experienced no stress factors throughout the gameplay, however felt calmer after the game, and would continue to use it if it can really help him relax.

4.2.1 Evaluation Using Wearable Device

A measured mental status evaluation was also conducted on one participant. *LULL* aims to be a serious game for stress reduction and improvement of mental well-being. Hence, a wearable device, that analyses the user's mental status by measuring respiration rate, was introduced into the evaluation method to identify the mental status of the participant. If proved effective as a serious game, the participant's respiration rate should drop and enter a calm state, which can be identified using a wearable device.

In 2016, Spire² launched a wearable device, Spire tracker, that detects respiration rate and defines the mental status of the user through breath per minute (bpm). It alerts users to slow their breathing to keep calm whenever it detects tension and stress. Connected to its app, it keeps track of the user's respiration rate and mental status whenever the user is wearing the device.

A Spire tracker was used on one participant of this research to conduct a mental status evaluation of *LULL*. Similar to the other four participants, evaluation methods include *pre-game*, *gameplay*, and *post-game* observation and interview (Chapter 4.1). However, different from the previous four participants, a Spire tracker was placed on the participant's waist to detect the respiration rate of the subject, also the participant used an iPhone 6s simulator on a laptop computer to conduct the evaluation instead on using an iPhone 6s.

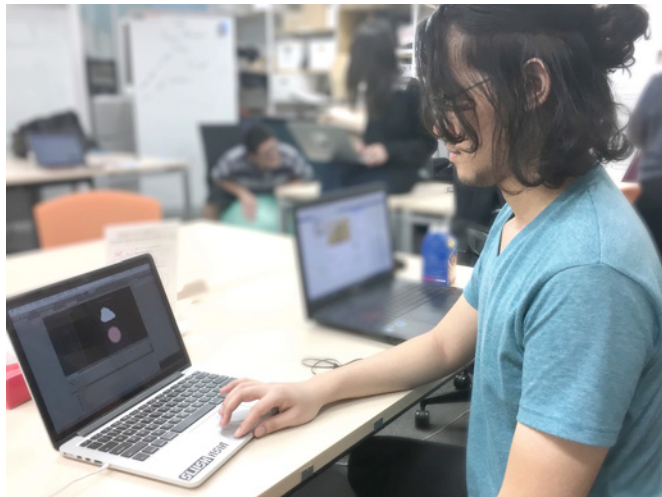


Figure 4.9: Interviewee 5

Interview Five

Pre-game The fifth participant of the user test is a 26 male, Pratt Institute Industrial Design 2nd year Master's Student, currently on an exchange program in KMD (Figure 4.9). In the pre-game interview, he states that he has been to a few yoga lessons before, however has shown interest in deep breathing before, and learned about it on the internet by himself. The subject understands the benefits of deep focused breathing, which includes reduce stress and keep calm, and also suggests that he does abdominal breathing without having to focus. However, when he feels stressed, he does not practice deep breathing exercises to relax. His current stress comes from his projects, worries about his future after graduation and financial state. Self-reported stress levels were experiencing stress, but not uncomfortable.

After the pre-game interview was conducted, a Spire tracker was clipped to his waist for measurements. The subject was asked to sit and relax for three minutes without given further instructions. The average respiration rate (bpm) during these three minutes acted as a standard for further observations. His average bpm was 17.8 before the gameplay, and breathing speed was unstable, jumping between 14-20 bpm.

In-game Game performance wise, the participant adapted to the game quickly and completed both levels without problems, matching both the rhythm of his breathing and the rhythm of scaling the energy orb. Gameplay wise, he spent half a minute to adjust his breathing in each level, and was able to master in a short time. Game experience wise, he smoothly activated all the events without problems.

The Spire tracker tracking his bpm (breath per minute), showed results as followed. In the first level, his bpm started from 17.8 and dropped into 12.8 in half a minute, then at the end of the game, reached 11.3 breaths per minute. Between the time of ending the first level and starting the next level, the subject's respiration rate slowly rose back to 17.8 bpm. Throughout the second level, the subject's respiration rate dropped significantly to 10 bpm in the first half minute, then slowly lowered to 7.5 bpm at the end of the game. Spire detected the breathing motions of the subject and stated it as a "calm" moment for the continued two minutes during the second level.

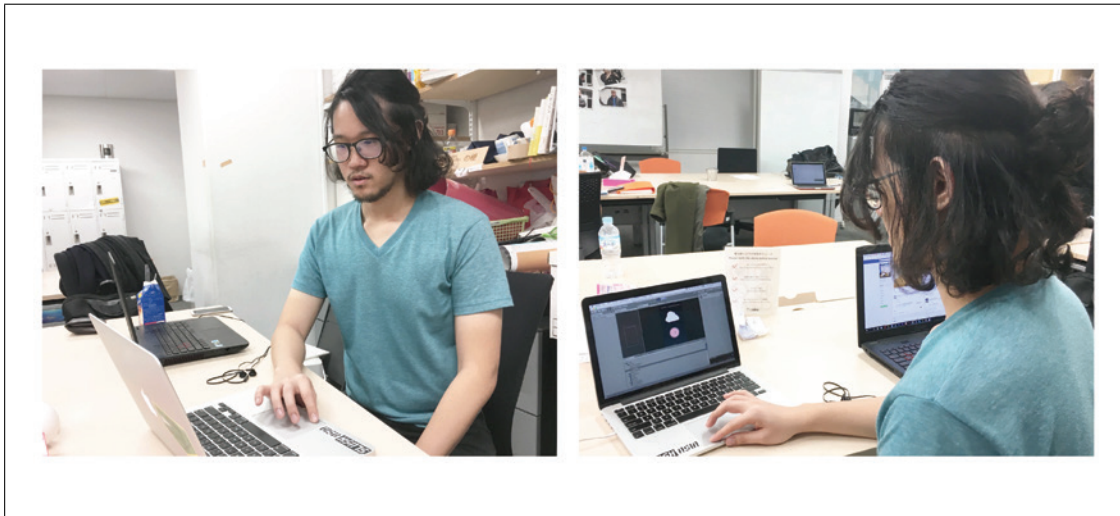


Figure 4.10: Participant 5 In-game

Post-game The participant reported having enjoyed the game experience, he expressed that it is easy to focus on breathing through the gameplay, the color change in the background environment is nice and soothing, the particle system designed to interact while breathing in and out is a good visualization of energy flowing in and out of the body. However, he does not like pressing and releasing the control orb while breathing in and out. The subject suggested a design of a product to act as control for users to hold in their hands while interacting with the game, squeezing and letting go of the product can also help with reducing stress, and may be more interesting for players. Self-satisfaction wise, the subject can adjust to both levels of the gameplay, and found the second level of gameplay more relaxing to follow, and can really feel the difference of breathing speed during the second level. He reported feeling calmer and reduce of stress after the game.

In the post-game observation and interview, the subject was given another three minutes to sit and relax, the subject's bpm rose back to an average of 17.5, however, was stable compared to the pre-game respiration rate, it ranged only between 17-18 in the three minutes.

Table 4.1: Subject Five Respiration Rate

	Pre-game	Gameplay	Post-game
Average bpm	17.8	12	17.5
Slowest bpm	14	7.5	17
Fastest bpm	20	17.8	18

4.3 Proof of Concept

All the participants are young adult individuals that represent potential user groups: male and female, students and full-time workers, with and without knowledge on breathing meditation, mindfulness or yoga. Discussions will focus on three areas: (1) Game Experience, (2) Stress Reduction, and (3) Measured Mental Status.

4.3.1 Game Experience

From the evaluations conducted on five participants, game experience related validations are listed below:

- All participants reported the game engaging and relaxing.
- Characters visualizing breathing is effective and engaging.
- All participants completed at least one Deep Breathing Meditation session through the game.

Through the gameplay, all participants understood how to play the game through the tutorial independently. All participants needed time to adjust their breathing the first time playing the game, but all learned and adjusted to the right speed throughout half the gameplay, which is only half a minute. In their second try on the game, they all mastered the control and the rhythm of the breathing, and could all conduct a perfect session of breathing meditation. Detailed results from interviews and observation are shown in Figure 4.11.

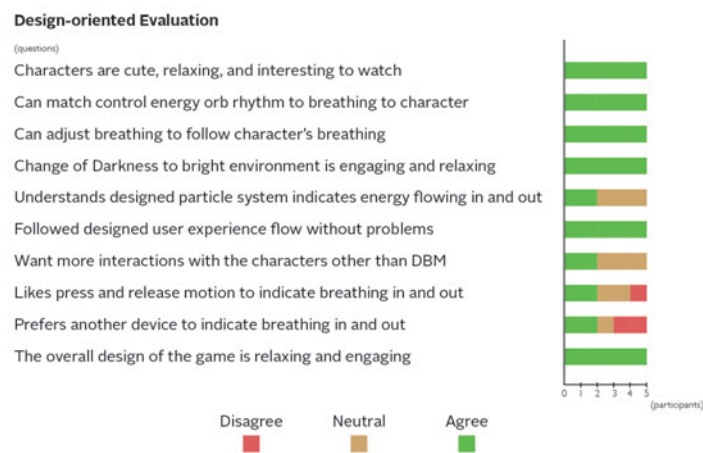


Figure 4.11: Results Graph

4.3.2 Stress Reduction

Considering self reported stress levels, the validation for stress reduction are listed as below:

- All participants felt a calmer state of mind compared to before the game.
- Most participants experienced significant stress reduction after the game.
- All participants are willing to conduct Deep Breathing Meditation through *LULL*.
- All participants showed significant drop of respiration rate during the game.

This observation proves that *LULL* can impact users as a serious game, to conduct Deep Breathing Meditation training through the game to reduce stress, hence improve their mental well-being. Analyzed results of intervention-oriented discussion is shown below (Figure 4.12).



Figure 4.12: Results Graph

In the observations of the In-game phase, there was one fact noticed, the breathing speed is different for every individual. Four out of five participants found the first level breathing speed comfortable, and can easily adjust to that speed of deep breathing, the second interviewee found the second level slower breathing speed more suitable, due to having trained for long breaths when playing instruments. The fifth interviewee can adjust easily to both levels of breathing speed in half a minute. The problem of breathing speed for each individual should be further discussed to create a serious game for breathing meditation training suitable for every user.

4.3.3 Measured Mental Status

In the fifth interview conducted, a Spire tracker was introduced to measure the mental status of the participant. *LULL* aims to be a serious game for mental health, therefore, the effectiveness of *LULL* is measured. By measuring the respiration rate of the participant, the Spire tracker can identify the state of the subject's mental mind. Respiration rate results are shown in Figure 4.13.

- Respiration rate significantly dropped during the gameplay.
- The participant's mental state entered a *calm* status identified by the Spire tracker through playing *LULL*.
- Significantly showed more steady respiration rate after the game.

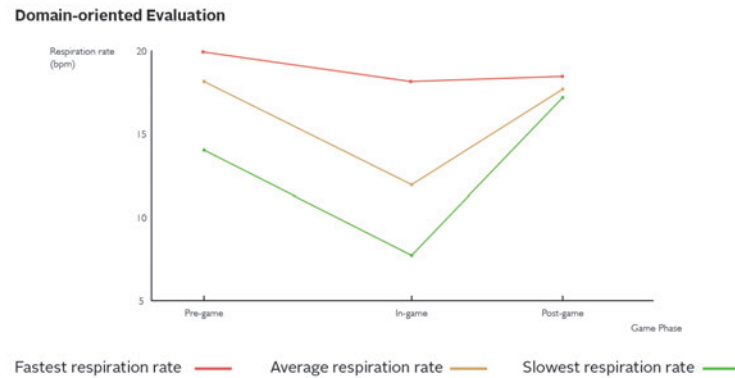


Figure 4.13: Results Graph

4.3.4 Summary

The data collected from observations and interviews on users supports the concept of *LULL*. Through *LULL*, it is easy to adjust and train to do Deep Breathing Meditation, thus reduce stress through conducting DBM. To conclude, the goal of this research, to design a serious game to improve mental well-being by combining Deep Breathing Meditation training and interesting gaming experience, is proven to be successful. Although there are still room for improvement and features to be developed for a better gaming experience, the core concept *LULL* has to deliver is confirmed to have positive results.

Notes

- 1 Apple iPhone 6s, <http://www.apple.com/shop/buy-iphone/iphone6s>
- 2 Spire, <https://spire.io/>

Chapter 5

Conclusion

The presented research and exploration focused the design language and approach of *LULL*. A serious game was developed to help users reduce stress and improve their mental well-being through engaging them in conducting Deep Breathing Meditation (DBM) through a gaming experience. *LULL* not only provides a more interesting and engaging way to practice DBM than traditional meditation training, but is also easily accessible almost anytime anywhere. Instead of having a formal meditation instructor teaching DBM, *LULL* visualizes specific exercises with cute breathing companions that accompany a player through a successful session. Rather than providing alerts and notifications that push users to practice DBM, a game-reward-system was designed in *LULL* to trigger the users to practice DBM in a more natural way. Through practicing DBM, it unlocks new companions and keep the former companions active, acting as a more engaging and instinctive motivation for users to continue practicing and learning. Through continuously going through this process, it is easy for users to adapt DBM practices into their daily lifestyle and learn the benefits of practicing DBM, thus become a go-to solution for users whenever they feel stressed. Building, reinforcing a habit and keeping player dedication is a key component and goal of *LULL*.

5.1 Design Approach

To complete the design concept of *LULL*, ethnographic research was first conducted, and through observation research and detailed analysis, a target persona was conceived to enhance the process of developing an initial concept. Ideation process was sought out to come up with a more refined concept, then the game was planned out and designed. Serious game design methods and an MDA formula for entertaining game design was taken into consideration in the design. The user experience framework was first designed, then the game characters, game world,

and gameplay was created to export the experience of the game to the users. Lastly, the prototype was developed and implemented onto an iOS platform for evaluation and user testing and feedback.

During the evaluation stage of *LULL*, observational research and interviews was conducted. The evaluation was performed on five individuals and divided into three phases; pre-game, in-game, and post-game observations and interview. In addition, one of the participants was required to use a wearable device to measure respiration rate during the process of meditation to produce tangible, reproducible data. Through the evaluations, the concept of *LULL* was proven to have initial success and positive results. The design intention of the game was proven relaxing and engaging, where all participants experienced a perceived stress reduction leading to a calmer state of mind after.

5.2 Limitations

This research aims to create a gaming experience that reduces stress and improves the mental well-being of users through combining Deep Breathing Meditation with serious gameplay. Users can access *LULL* whenever they are experiencing stress, and by learning and practicing DBM through the gameplay, a calmer state of mind can be achieved. However, considering the mental state of each individual, the effectiveness of the game may differ and the evaluation, while yielding positive results, has only been conducted on non-patients in this research.

Using serious games as an approach to reduce stress through DBM, *LULL* has shown promising results on guiding users to practice DBM in an interesting and engaging way. In the designed gameplay, however, the breathing speed of the beginning level was sometimes too fast or too slow for users, considering each user's knowledge and previous practice with DBM. A takeaway is that the game should be able to adjust the respiration rate for each individual user. The game also requires users to focus on the visuals on a smartphone screen, therefore, under certain stressful situations when a smartphone is not accessible, another solution must be used.

Another limitation of the research, is that evaluations were only conducted for short period of time on the participants. Due to the time limitations for this conducting this research, although it is predicted that it will show promising results on user's mental well-being for the long term, it is not proven yet by the long-term evaluations at this current stage of development. Based on the previous

research on meditation and through extrapolation, by continuing using *LULL*, it will help users in managing stress throughout their daily lives and improve their mental health.

The evaluations conducted in this research also are not equivalent to a medical research, because of cost and available facilities and the serious regime that a medical trial requires, therefore, the effectiveness of *LULL* as a medical solution in improving mental well-being has much room to be further discussed.

5.3 Future Discussions

Based on the feedback provided by the participants in the evaluation process, there are three main features of the design that can be further developed: (1) adjust respiration rate considering each individual user, (2) the design of a device to still access the game for when the user cannot look at a screen, and (3) deeper interactions between the characters and user. By expanding the game world and gameplay, it can lead to a better experience for the users. The core of the game, however, should and must still be learning and practicing DBM. With a variety of planned updated functions implemented into the game, the attractiveness of the game is expected to increase.

Future evaluation for long-term benefits should also be conducted to evaluate the effects and impact on users mental health. In the current stage, *LULL* is only proven successful on non-patients young adults, however, *LULL* has the potential to become (1) a medical aid for improvement of mental well-being for patients, or (2) a parent or teacher's aid for helping children focus and stay calm.

Medical Aid Possibility Clinical trials have to be conducted to evaluate the effectiveness of *LULL* for patients. If proven successful, more types of meditation training can be embedded and designed into the game to aid patients as a certified medical device. It can also be a way for doctors to keep track of health data of their patients in a less stressful way. By accessing the data of the game, doctors should be able to keep track of the mental state of their patients, and in addition, adjust the game for each individual.

Children User Groups As a parent or teacher's aid for helping maintain the focus of children or calming the mental state of children, the designs and interaction of the game can be relaxing, soothing, and attractive for children. By

conducting DBM through *LULL* before a presentation or a contest, it can help children ease anxiety and stage fright and allow them to focus on the task on hand. Under situations where a child has to stay calm and quiet, such as on a plane, *LULL* can be a solution for parents to give to children to play.

Summary *LULL* has created a new direction for serious games in their application to improving and maintaining a robust, strong, and healthy mental state. There is promising and very strong potential in designing serious games as medical aids, and can lead to further beneficial research in this field. *LULL* provides a viable solution to the stress from the overwhelming nature our current society imposes upon young, working adults and paves the road for serious games as viable medium in achieving a healthy mind.

References

- Arnab, Sylvester, Theodore Lim, Maira B. Carvalho, Francesco Bellotti, Sara de Freitas, Sandy Louchart, Neil Suttie, Riccardo Berta, and Alessandro De Gloria (2015) “Mapping learning and game mechanics for serious games analysis,” *British Journal of Educational Technology*, Vol. 46, No. 2, pp. 391–411.
- Association, American Psychological (2012) “Stress by Generations.”
- Biron, Caroline and Maria Karanika-Murray (2014) “Process evaluation for organizational stress and well-being interventions: Implications for theory, method, and practice.” *International Journal of Stress Management*, Vol. 21, No. 1, pp. 85 – 111.
- Boyle, Elizabeth A., Thomas M. Connolly, Thomas Hainey, and James M. Boyle (2012) “Engagement in digital entertainment games: A systematic review,” *Computers in Human Behavior*, Vol. 28, No. 3, pp. 771 – 780.
- Boyle, Elizabeth, Thomas M. Connolly, and Thomas Hainey (2011) “The role of psychology in understanding the impact of computer games,” *Entertainment Computing*, Vol. 2, No. 2, pp. 69 – 74, Serious Games Development and Applications.
- Chittaro, Luca and Riccardo Sioni (2014) “Evaluating mobile apps for breathing training: The effectiveness of visualization,” *Computers in Human Behavior*, Vol. 40, pp. 56 – 63.
- Deterding, Sebastian, Dan Dixon, Rilla Khaled, and Lennart Nacke (2011) “From Game Design Elements to Gamefulness: Defining ”Gamification”,” in *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, MindTrek ’11, pp. 9–15, New York, NY, USA: ACM.

REFERENCES

- Green, C.S. and D. Bavelier (2006) “Enumeration versus multiple object tracking: the case of action video game players,” *Cognition*, Vol. 101, No. 1, pp. 217 – 245.
- HICKMAN JR., RONALD L., JOHN M. CLOCHESY, MELISSA D. PINTO, CHRISTOPHER BURANT, GRANT PIGNATIELLO, and Ronald L Jr Hickman (2015) “IMPACT OF A SERIOUS GAME FOR HEALTH ON CHRONIC DISEASE SELF-MANAGEMENT: PRELIMINARY EFFICACY AMONG COMMUNITY DWELLING ADULTS WITH HYPERTENSION.,” *Journal of Health & Human Services Administration*, Vol. 38, No. 2, pp. 253 – 275.
- Hunicke, Robin, Marc Leblanc, and Robert Zubek, “A Formal Approach to Game Design and Game Research,” in *Game Developers Conference*.
- M, Goyal, Singh S, Sibinga ES, and et al (2014) “Meditation programs for psychological stress and well-being: A systematic review and meta-analysis,” *JAMA Internal Medicine*, Vol. 174, No. 3, pp. 357–368.
- MARCHAND, WILLIAM R. MD (2012) “Mindfulness-based stress reduction, mindfulness-based cognitive therapy, and Zen meditation for depression, anxiety, pain, and psychological distress,” *Journal of Psychiatric Practice*, Vol. Volume 18, July 2012, No. 4, p. 233252.
- , “Fifteen Minutes of Chair-Based Yoga Postures or Guided Meditation Performed in the Office Can Elicit a Relaxation Response.”
- Paul, Gina, Barb Elam, and Steven J. Verhulst (2007) “A Longitudinal Study of Students’ Perceptions of Using Deep Breathing Meditation to Reduce Testing Stresses,” *Teaching and Learning in Medicine*, Vol. 19, No. 3, pp. 287–292, PMID: 17594225.
- Rapgay, Lobsang and Alexander Bystrisky (2009) “Classical Mindfulness,” *Annals of the New York Academy of Sciences*, Vol. 1172, No. 1, pp. 148–162.
- Sharma, Manoj (2014) “Yoga as an Alternative and Complementary Approach for Stress Management: A Systematic Review,” *Journal of Evidence-Based Complementary & Alternative Medicine*, Vol. 19, No. 1, pp. 59–67.

REFERENCES

- Timothy J. Schoenfeld, Pedro R. Pieruzzini Brian Hsueh Elizabeth Gould, Pedro Rada (2013) “Physical Exercise Prevents Stress-Induced Activation of Granule Neurons and Enhances Local Inhibitory Mechanisms in the Dentate Gyrus,” pp. 7770–7777.
- Tomaka, Dept of Psychology El Paso US Blascovich Jim, Joe. U Texas (1994) “Effects of justice beliefs on cognitive appraisal of and subjective physiological, and behavioral responses to potential stress,” pp. 732–740.

Appendices

A Game Interface Design

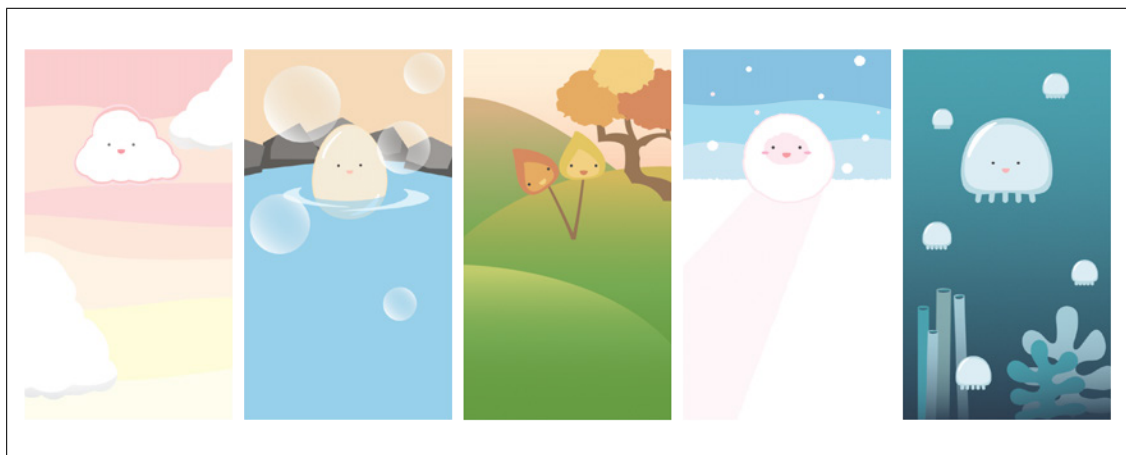


Figure A.1: Game Interface Design

B Concept Video

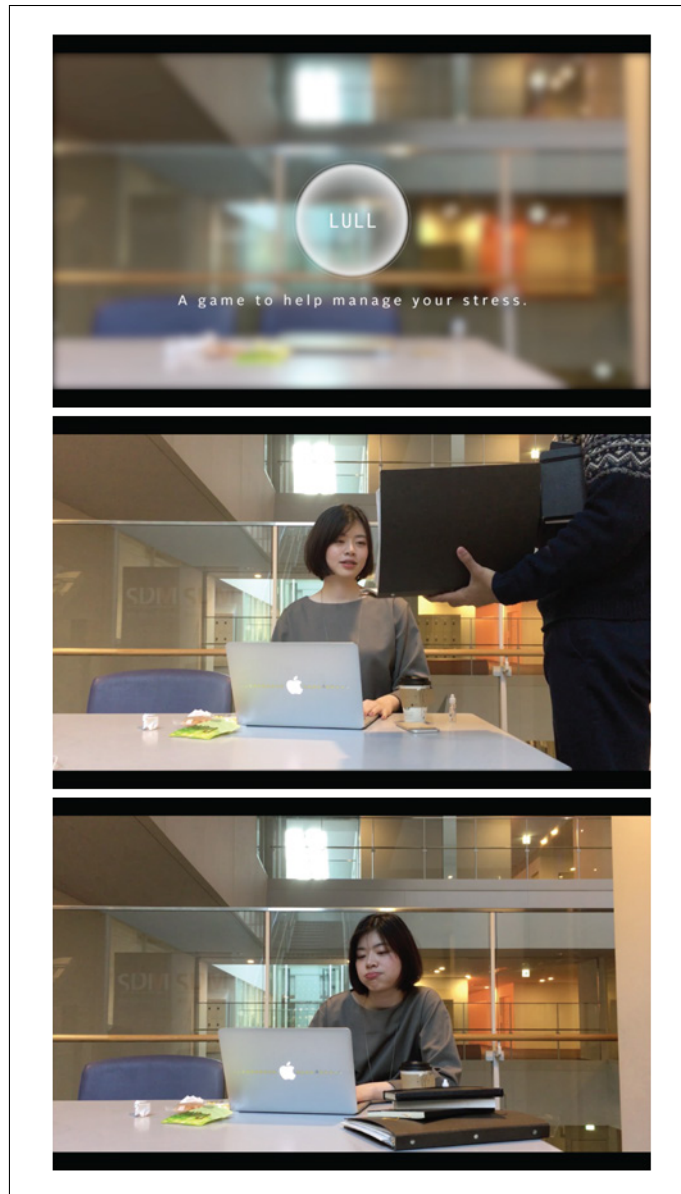


Figure B.1: Concept Video

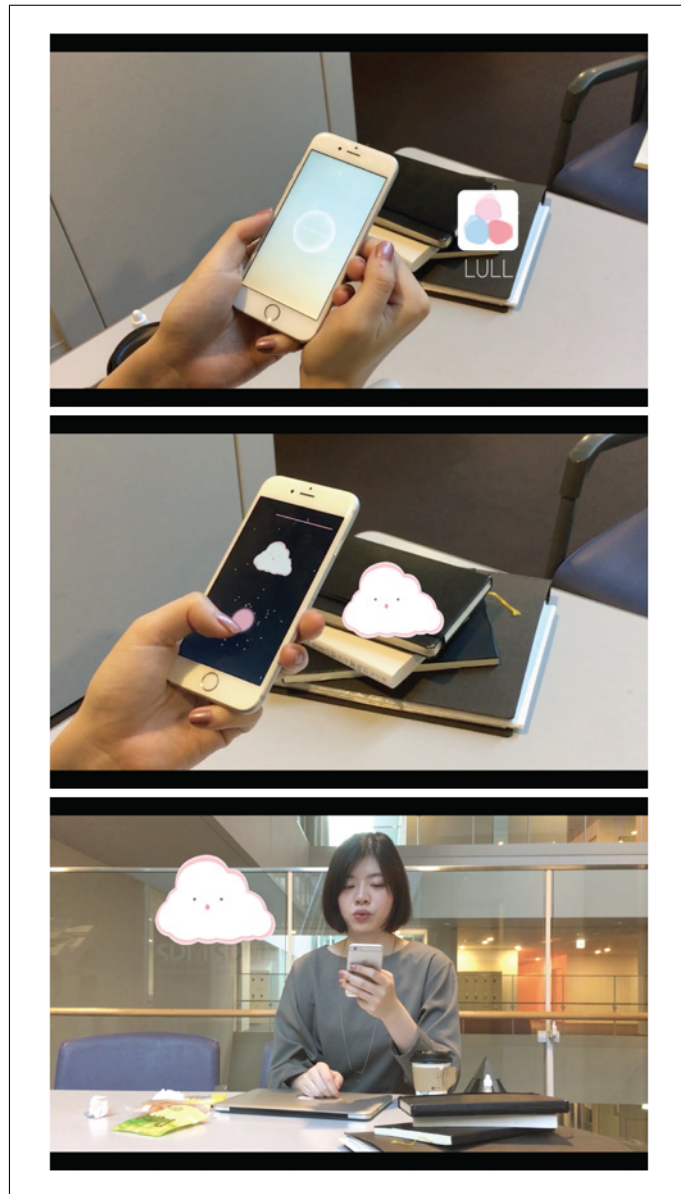


Figure B.2: Concept Video

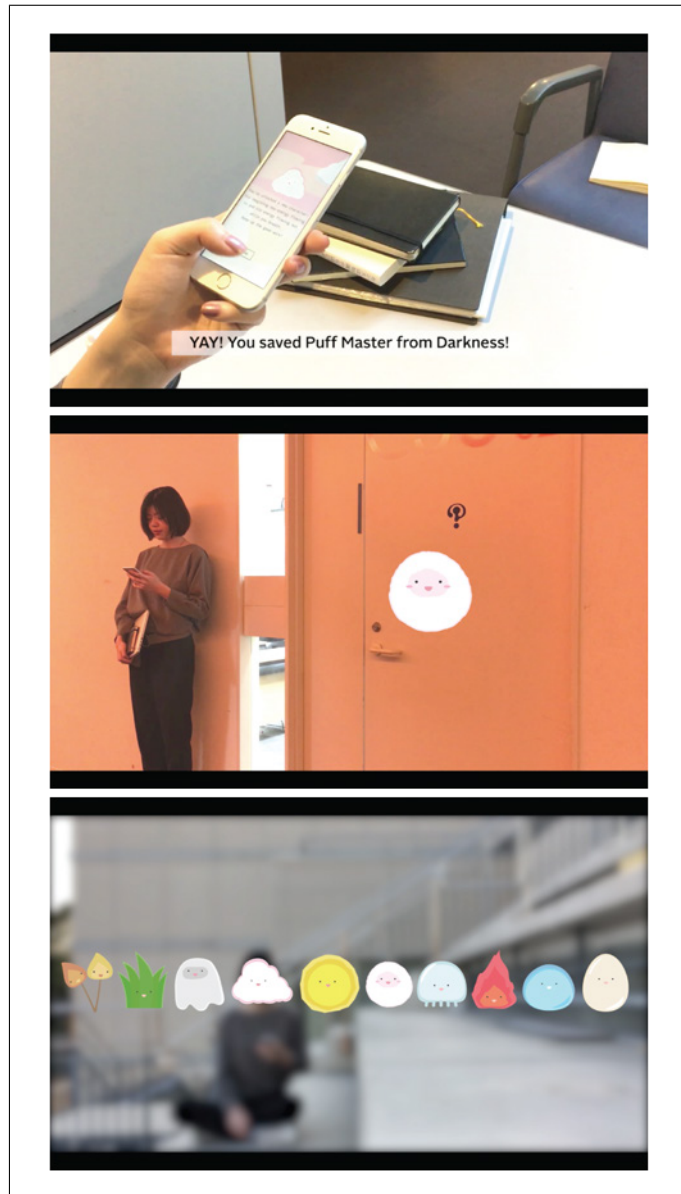


Figure B.3: Concept Video

C Codes in C Sharp

C.1 Touch Control Codes

```
using UnityEngine;
using System.Collections;

public class TouchControl : MonoBehaviour {

    public float Speed = 1f;
    public GameObject BreathIn;
    public GameObject BreathOut;

    private Vector3 curScale;

    // Use this for initialization
    void Start () {

        curScale = new Vector3 ( 1, 1, 1);
        BreathIn.SetActive (false);
        BreathOut.SetActive (false);
    }

    // Update is called once per frame
    void Update () {
        // press space Inhale
        if (Input.GetKey (KeyCode.Mouse0)) {
//         if (Input.GetTouch(0).phase == TouchPhase.Began &&
            Input.GetTouch(0).phase == TouchPhase.Stationary) {
                curScale.x += 1f * Speed * Time.deltaTime;
                curScale.y += 1f * Speed * Time.deltaTime;
                curScale.z += 1f * Speed * Time.deltaTime;

                BreathIn.SetActive (true);
                BreathOut.SetActive (false);

                transform.localScale = curScale;

                if (curScale.x > 3f) {
```

```
                curScale = new Vector3 (3,3,3);
            }
        } else {
            curScale.x -= 1f * Speed * Time.deltaTime;
            curScale.y -= 1f * Speed * Time.deltaTime;
            curScale.z -= 1f * Speed * Time.deltaTime;

            BreathIn.SetActive (false);
            BreathOut.SetActive (true);

            transform.localScale = curScale;
            if (curScale.x < 1f) {
                curScale = new Vector3 (1,1,1);
            }
        }
    }
}
```

C.2 Points Codes

```
using UnityEngine;
using System.Collections;
using UnityEngine.UI;

public class CountTime : MonoBehaviour {

    public GameObject Orb;
    public float totalElapsedTime = 0;           //for one minute
    public float breathSpeed = 5;
    public float winScore = 5;
    public float gameTime = 60;

    // public Text DisplayText;

    public GameObject WinText;
    public GameObject LoseText;
    // public GUIText DisplayScore;

    public int score = 0;
```

```
private float elapsedTime = 0; //for 3 sec

private bool inhale = true;

// Use this for initialization
void Start () {

}

// Update is called once per frame
void Update () {

    totalElapsedTime += Time.deltaTime;
    elapsedTime += Time.deltaTime;

    if (elapsedTime > breathSpeed) {

        if (inhale) { //close to scale 9
            if (Orb.transform.localScale.x > 2.5) {
                score++;
                Debug.Log ("point++ ");
            }
        } else { //close to scale 5
            if (Orb.transform.localScale.x < 1.5) {
                score++;
                Debug.Log ("point++ ");
            }
        }

        inhale = !inhale; //invert inhale exhale
        elapsedTime = 0; //reset 3 sec
    }

    // one minutes passed, win or lose
```

```
        if (totalElapsedTime >= gameTime) {

            //win
            if (score >= winScore) {

                WinText.SetActive (true);

            } else {        //lose

                LoseText.SetActive (true);

            }

            Orb.SetActive (false);
            gameObject.SetActive (false);

        }
    }
}
```

C.3 Select Character Codes

```
using UnityEngine;
using System.Collections;
using UnityEngine.UI;

public class ClickCharacter : MonoBehaviour {

    public GameObject CloudCanvas;
    public GameObject EggCanvas;

    // Use this for initialization
    void Start () {

    }

    // Update is called once per frame
    void Update () {
```

```
    }  
  
    public void CloudClicked(){  
  
        Debug.Log ("You have clicked the button!");  
        CloudCanvas.SetActive (true);  
        gameObject.SetActive (false);  
  
    }  
  
    public void EggClicked(){  
  
        Debug.Log ("You have clicked the button!");  
        EggCanvas.SetActive (true);  
        gameObject.SetActive (false);  
  
    }  
}
```