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Master's Thesis
Academic Year 2024

Moment: Rethinking Mindfulness Accessibility
through Interactive and Immersive Design



Keio University
Graduate School of Media Design

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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

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Abstract of Master's Thesis of Academic Year 2024

Moment: Rethinking Mindfulness Accessibility through Interactive and Immersive Design

Category: Design

Summary

Mindfulness, a state of present-moment awareness, is widely recognized as an effective method for reducing stress and enhancing focus. However, traditional mindfulness practices face barriers such as time constraints, lack of understanding and delayed results. This research identifies these accessibility gaps and explores how interactive and immersive design can offer a more inclusive alternative. The interactive system “*Moment*” was developed to make mindfulness practice more engaging and accessible through principles of Flow and Gamification, helping individuals who struggle with traditional approaches. The system was tested against the guided meditation app Headspace using the State Mindfulness Scale for Physical Activity. Findings suggest that immersive and playful mindfulness experiences can reduce cognitive barriers, improve engagement, and serve as an entry point for those who find conventional practices challenging. This research contributes to the ongoing discussion on making mindfulness more accessible, offering insights into how it can be more inclusive.

Keywords:

mindfulness, accessibility, immersive technology, gamification, flow, interactive projection

Keio University Graduate School of Media Design

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Chapter 1

Introduction

This chapter outlines the concept, motivation, and goal of this research, along with contributions and overall thesis structure.

1.1. Motivation

1.1.1 Mindfulness In a World Full of Distraction

Mindfulness, a state of present-moment awareness. Is often regarded as a universal solution for mental well-being, reducing stress, and enhancing focus. This is particularly relevant to people like me, who find themselves consuming mindless contents shoved by the social media algorithms, often without realizing until it's too late. The rise of low-effort content created by generative artificial intelligence has worsened this issue. Affecting people across all age groups, to even my precious grandma, who now sends me AI-generated uncanny videos of dancing cats and dogs. This hilarious yet grim situation has made me reflect on the importance of being more mindful of what we consume, and how mindfulness might be the key to breaking free from this cycle of mindless, doom-driven consumption.

However, despite knowing the numerous benefits, integrating mindfulness practice into daily life proved to be a constant challenge for me. This research is deeply personal, stemming from my repeated attempts and failures at consistently practicing mindfulness. From meditation, yoga, journaling, exercising, to walking, yet I've often felt unsure whether these efforts were truly helping. This struggle led me to explore the very concept of mindfulness: What counts as mindfulness? How can I tell if it's working? And most importantly, can it be made easier and more accessible for people like me?

Research shows that mindfulness is disproportionately practiced by highly edu-

cated and high-income individuals, with financial and time constraints preventing many from engaging in consistent practice [1, 2]. Even modern solutions, such as mindfulness apps, claim to make meditation more accessible, yet many users still report overwhelm, difficulty maintaining engagement, and financial barriers due to subscription models [3].

Recognizing these challenges, I became interested in rethinking mindfulness accessibility. Could mindfulness be made perhaps more engaging, and more accessible to those who struggle with traditional practices? A potential answer may perhaps be found in the world of immersive technology, an emerging medium that has been used to captivate and engage users in unique ways.

1.1.2 Immersive Culture & Goals

Having the chance to study in Tokyo, London, and New York exposed me to various technologies and seeing how it was used in the world. One thing that stood out to me was the use of immersive technologies in public space to help with mindfulness. I saw immersive technology as a playful and effective way of creating engagement in people of all ages. The experience at Tokyo’s teamlabs, London’s Outernet, New York’s Mercer Labs, left me with hope and excitement for this emerging medium. Yet, I also noticed a paradox.

These spaces promoting mindfulness and present-moment appreciation, become hotspots for taking photos for social media. This observation led me to explore how immersive technology can help foster genuine mindfulness without drawing attention to phones, Creating an experience where mindfulness can emerge organically, free from smartphones and other distractions.

1.1.3 Contribution

This research contributes to the fields of design, human-computer interaction, and mindfulness accessibility by evaluating the effectiveness of *Moment*, an interactive system that integrates playfulness and mindfulness through immersive projection, Flow theory, and gamification. By comparing *Moment* to the widely used guided meditation app Headspace, this study explores how interactive and immersive design can lower barriers to mindfulness practice. Through an iterative design

process, user behaviors are observed, and self-reported data is collected using the State Mindfulness Scale for Physical Activity (SMS-PA) to assess engagement, effectiveness, and accessibility. The following research questions guide this study:

1. **Research Question 1:** How does an interactive, gamified mindfulness intervention affect state mindfulness (thoughts, emotions, and body) compared to guided meditation?
2. **Research Question 2:** How does the perceived impact of mindfulness practices differ between interactive and traditional approaches?
3. **Research Question 3:** How do Flow principles and gamification in an interactive mindfulness intervention enhance the overall experience and mindfulness outcomes?

1.1.4 Thesis Structure

- **Chapter 1: Introduction** - Discussion of background, motivations, and goals of this research.
- **Chapter 2: Literature Review** - Exploration of existing research and case studies of mindfulness, Flow theory, gamification, and immersive technology to better understand the concept.
- **Chapter 3: Concept Design** - Design and iterative process of creating *Moment* and immersive playful approach to mindfulness, including user testings, and development of software using TouchDesigner.
- **Chapter 4: Evaluation** - Findings and data of the user tests, seeing how *Moment* compares to guided meditation app *Headspace*, and evaluating design elements.
- **Chapter 5: Conclusion** - Summary of research, its limitations, and potential for future development.

Chapter 2

Literature Review

To get a better idea of the ‘what’, ‘why’, and ‘how’, we will first explore existing literature and related works on mindfulness. We will then explore the impact of playfulness through gamification and Flow on mindfulness practices. Then finally, case studies of immersive designed spaces from three cities; Tokyo, London, and New York, observing how different cultures engage with immersive experiences, and how it impacts mindfulness.

2.1. Mindfulness

2.1.1 What is mindfulness?

Mindfulness is most commonly referred to as the state of being fully aware of the present moment [4]. Achieving this state of present-moment awareness, has been shown to reduce stress and anxiety, as well as increasing focus, amongst the many psychological benefits [5]. Fundamentally, this state emerges through the act of paying attention to a purpose and unfolding the present moment in a nonjudgmental way [6]. This state can be cultivated, developed, and enhanced over time through “informal” and “formal” mindfulness practices [6].

Informal practice is the act of “turning off auto pilot from your daily life”, allowing oneself to be in the moment [7]. An example of informal mindfulness practice, could be something as trivial as mindful dishwashing. Which has been researched to show reduction of nervousness by simply being aware of our experiences such as thoughts, emotions, and movements while washing dishes [8].

On the other hand, Formal mindfulness practice involves dedicating intentional time to an activity [7] such as meditation, yoga, or in this example, eating raisins. Kabat-Zinn (2003) [6] conducted an experiment where the participants mindfully

ate raisins to focus on the sensory experience, observing the taste, texture and smell. The experiment demonstrated how mindfulness can be cultivated through structured activities to help reduce habitual distractions.

2.1.2 Awareness: The Key to Mindfulness

While informal and formal practices have their distinct differences, the path to mindfulness is the same. And that is through awareness. Both types of practices focus on the act of (1) intentionally focusing on the present moment, through observation of one's thoughts or experiences, (2) enabling intentional choices over habitual reactions, (3) observing experiences through non-judgmental lenses, and (4) acknowledging and accepting reality as it unfolds [9]. These four points demonstrate how awareness acts as a prerequisite for mindfulness.

2.1.3 Barriers to Mindfulness

Mindfulness, while recognized for its wide range of benefits, often remains underpracticed due to several barriers limiting its accessibility. The commitment to a task that requires sitting with one's own thoughts, an uncomfortable experience with no immediate benefits, often discourages people from practicing it regularly. This avoidance of confronting difficult emotions during meditations can make the practice feel even more challenging for beginners, discouraging regular practice [10].

Study conducted by Van Dam et al. (2018) [11] found that emotional distress and physical discomfort, high expectations, misunderstanding of practice, lack of guidance, and psychology are factors that make practicing mindfulness difficult. Additionally, Manuel (2021) [12] identified time and opportunity constraints as the key barrier. Lack of opportunities like access to suitable environment, resources, and freedom from external pressures. This resulted in individuals struggling to prioritize mindfulness over daily responsibilities, making it difficult to integrate mindfulness practice into their routine.

These challenges are further highlighted by a meta-analysis of 114 studies on Mindfulness-Based Interventions (MBIs), which found an average dropout rate of 19.1% for MBIs and 18.6% for control groups [13]. This shows the difficulty

of keeping people engaged, even during well-structured mindfulness programs, suggesting how traditional mindfulness approaches may not work for everyone.

This aligns with findings from a preliminary survey conducted on 18 students of Keio University’s Graduate School of Media Design, where despite all individuals recognizing the benefits of mindfulness for stress reduction, only half practiced it. Each mentioning lack of time and commitments as the primary barriers

Overall, these findings suggests that traditional mindfulness practices are often perceived as both emotionally and practically inaccessible, particularly for younger individuals or those with busy schedules. This resulted in the development of modern mindfulness solutions aimed at addressing these barriers. However, as explored in the next section, these modern approaches present challenges of their own.

2.1.4 Modern Solutions

Modern technologies such as smartphone apps and immersive tools aim to make mindfulness more structured and engaging. However, these approaches introduces new challenges, including accessibility, technological barriers, and ethical issues.

Smartphone apps like Headspace and Calm have shown measurable benefits in improving mental well-being. For example, Headspace has demonstrated significant reduction in stress level, with a 23.52% average decrease on the Perceived Stress Scale, improvements in depressive symptoms, and overall improvements of well-being [14]. These apps offer guided meditations tailored to various needs, providing a convenient entry point for beginners [15].

However, despite their user-friendly design, these solutions present some drawbacks. Many users find the wide selection of programs overwhelming and the need to carve out time for app-based practices inconvenient for their busy schedules [3]. Additionally, the subscription fees, while more affordable than classes or mindfulness retreats, still present a financial barrier for some users.

Immersive technologies, such as VR-based meditation experiences, have also emerged as innovative solutions. With research showing that VR-based mindfulness interventions can make mind–body exercises more engaging for older adults, improving mental health, pain management, and well-being (Gao et al., 2024) [16]. However, while modern solutions address some traditional barriers, new challenges

present themselves through the introduction of technology. Physical discomfort from headsets, difficulties in navigating interfaces, and cognitive overload have been a commonly cited drawback, lessening VR tool’s effectiveness on mindfulness [17].

Despite these drawbacks, technology has provided an accessible and engaging entry point for individuals uncertain about traditional mindfulness practices. Guided meditation apps offers structured guidance to beginners, removing uncertainty [14]. Similarly, VR experiences create an environment where users can engage with mindfulness without prior knowledge or training [18].

These tools lower the cognitive barrier by making mindfulness more interactive and rewarding compared to traditional approaches [10]. However, while they introduce new ways to engage with mindfulness, the financial and technological barriers still persists. Subscription costs, the need for expensive hardware, and the reliance on smartphones or VR headsets exclude individuals who lack access to these resources [17].

Despite their promises of accessibility, modern mindfulness solutions largely caters to those with financial means, showing how the mindfulness can be seen as a luxury trend for the privileged rather than an accessible tool for mental well-being.

2.1.5 Mindfulness as a Luxury Trend

While mindfulness is often promoted as a universally beneficial practice, its accessibility is disproportionately favored by the privileged [19]. Expensive meditation retreats, premium app subscriptions, and high-end wellness programs have positioned mindfulness as part of an elite lifestyle rather than an accessible mental health tool [20].

Research indicates that mindfulness practices such as meditation, yoga, and tai chi are disproportionately practiced by individuals with higher education and income levels. Those who have education beyond high school are four times more likely to engage in these practices than those with less education [1].

Furthermore, study on low-income African American groups found that mindfulness practices often feel inaccessible due to cost, time constraints, and cultural perceptions. While participants recognized the potential benefits of mindfulness,

financial instability and lack of free time prevented them from practicing consistently. Additionally, participants suggested that mindfulness interventions should be tailored to address these barriers to improve accessibility [2].

These findings show that despite being perceived as universally beneficial, mindfulness practices remain largely inaccessible to those without financial and social privilege. As mindfulness continues to be commercialized and positioned as an upper-class, it is essential to explore more accessible and inclusive alternatives.

2.1.6 Can Brief Meditation Be Effective?

One possible solution is to rethink traditional mindfulness practices to fit the realities of modern life. Since time constraints are a major barrier, when designing an accessible meditation experience for today's fast-paced world, a crucial question arises: Can mindfulness be effectively practiced within a brief span of time?

Research by Microsoft [21] tested whether a short 10 minute break between meetings can lower stress levels. As shown in Figure 2, users that take short breaks between meetings showed a reduction in stress levels after the break. Users who took zero breaks during the two hours of meeting showed higher cumulative levels of stress and spikes of stress levels. This proved that a short 10 minute break can have valuable positive effects not only during the break, but throughout the day.

Despite this, many individuals perceive breaks as a waste of valuable time out of their busy schedule, along with not being able to perceive immediate results, has led to poor habit formation [21]. Therefore, research emphasized the importance of building breaks into work routines, or work environments. It is also important to note the difference between break and entertainment. Effective use of break time should be used on mindfulness activities, such as short meditation, mindful walking, and reflecting on the present moment, rather than diverting attention through entertainment [22].

Another study by Miller et al., (2019) [23] investigated the effects of daily "Three-Minute Breathing Space" on university students over one semester. The intervention group reported enhanced positive emotions, reduced mind wandering, and less distractibility compared to the control group. This suggests that brief mindfulness practices taking less than 5 minutes, can positively influence one's mental health.

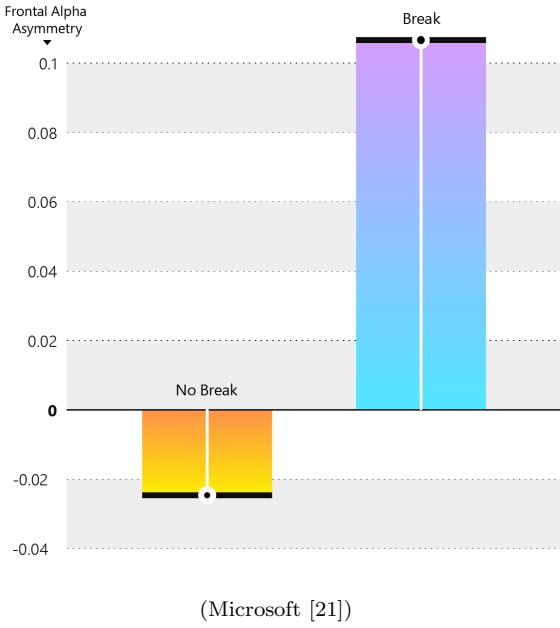


Figure 2.1 Taking Breaks Helps You Engage Better

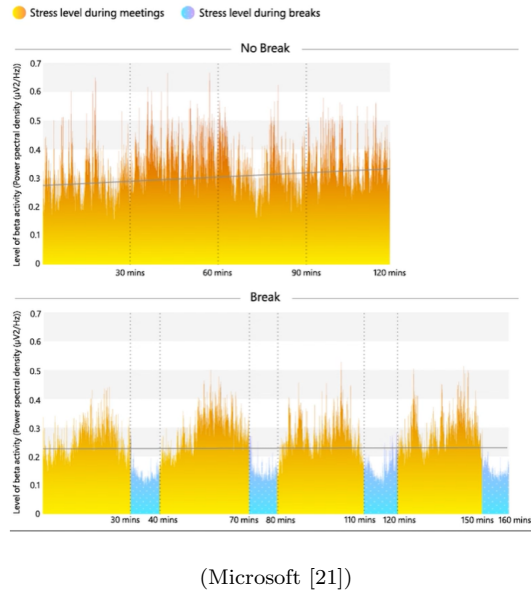


Figure 2.2 Taking Breaks Between Meeting Eases Stress

Yet again, research by Kuyken (2023) [24] involving 28,000 students aged 11–16, found that many mindfulness studies emphasize increasing meditation practice while overlooking broader issues like poverty, inequality, and mental health. Factors that often make consistent mindfulness practice inaccessible. The study highlights the need for tailored interventions that address accessibility barriers and adapt to the specific needs of different populations.

If traditional and modern mindfulness methods struggle with accessibility and engagement, how can we make mindfulness more user-friendly? One potential solution lies in Flow and Gamification, approaches designed to create naturally engaging experiences.

2.2. Flow & Gamification

2.2.1 Flow State

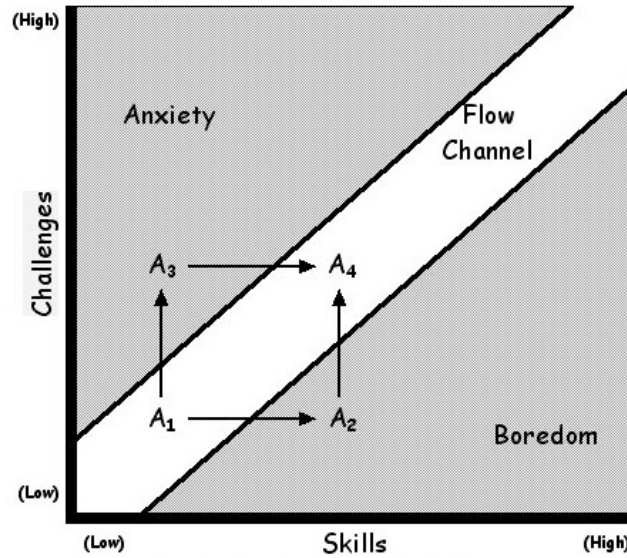
Csikszentmihalyi (1990) [25] defines the concept of ‘Flow’ as a state of complete immersion in an activity, characterized by complete immersion in an activity, immense focus, invigoration, and absorption in the present moment. This state has been associated with improved mental well-being and happiness, such as reduced anxiety, stress, enhanced creativity, and a greater sense of fulfillment (Csikszentmihalyi, 1990) [25].

2.2.2 Flow & Mindfulness

While Flow and Mindfulness share similar elements, they are not the same (How Are Mindfulness and Flow State Connected?, 2020) [26]. Mindfulness is the cultivation of self-awareness through being open to internal states and surroundings, while Flow is the loss of self awareness through deep absorption in tasks (How Are Mindfulness and Flow State Connected?, 2020) [26].

Study by Sheldon et al., (2015) [27] highlighted the incompatible nature between these two noting that mindfulness’s focus on sense of self is lost during Flow. However, the study also demonstrated that Flow can serve as an accessible entry point into mindfulness, particularly for those who struggle with traditional meditation techniques. Engaging individuals in Flow-based experiences can reduce the

cognitive resistance that's often associated with formal mindfulness practices [11].



(Source: Flow: The Psychology of Optimal Experience [25])

Figure 2.3 Diagram Showing The Relationship Between Challenges And Skill

2.2.3 Considerations of Flow States

There are four conditions to consider when designing an activity to reach the state of flow, and that is how the activity must have 1. A built in goal, 2. Immediate feedback, 3. Sets of rules, and 4. Challenges that match the user's skill level [25]. However, this goal-oriented approach to achieving Flow must be designed with caution, as setting goals can create unnecessary pressure and an outcome oriented mindset, which contradicts with the non-judgmental nature of mindfulness practice [28]. These findings highlight the contradictions between Flow and mindfulness, suggesting that Flow is better suited as an introduction to mindfulness rather than being directly combined with it.

2.2.4 Cases of Flow & Mindfulness

So how have Flow and Mindfulness been used together? Csikszentmihalyi (1990) [25] suggests that in formal practices like Yoga, Flow serves as the stepping stone, allowing practitioners to enter a state of focus and immersion, before progressing towards that deeper meditative state of Samadhi, where practitioners enter the state of inner reflection and mindfulness. Similarly, in an experiment by Zhang et al. (2021) [29], participants practicing Tai Chi reported experiencing Flow state characterized by deep concentration and a sense control, followed by reflection of internal states, aligning with mindfulness practices. These sequences demonstrate that Flow can act as an entry point before later transitioning into mindfulness, and acquiring the benefits that comes with the practice such as reduced anxiety and mindfulness [30].

2.2.5 Implementations For Accessibility

Research by Kee and John Wang (2008) [31] involving 182 athletes indicated direct links between Flow and mindfulness, showing how individuals with higher mindfulness levels are more likely to experience Flow states. Conversely, experiencing Flow can enhance mindfulness by strengthening the sense of awareness and focus. Additionally, Flow can make mindfulness more accessible as a more engaging and enjoyable entry point, compared to traditional methods like meditation which can be confusing and challenging for beginners, particularly when lacking guidance or psychoeducational support [32]. These findings suggest that integrating elements of Flow into mindfulness practices can mutually reinforce their benefits as well as making them more accessible, which aligns with Kyuken's (2023) [24] recommendation for making mindfulness practice tailored to meet unique needs of different groups.

2.2.6 Mindfulness & Gamification

Gamification is the concept of integrating game elements such as points, progress indicator, leaderboards into non-game contexts to enhance engagement [33]. This approach is particularly effective with younger demographics like students. who have demonstrated a preference for learning activities that incorporate gamifica-

tion, as it showed higher engagement and more enjoyment [34]. However, there are potential drawbacks to consider, such as emphasis on rewards and excessive game elements could hinder the intrinsic benefits of mindfulness [35]. Similar to Flow, the goal-oriented nature of gamification contradicts the non-judgmental nature of mindfulness [36].

Despite this challenge, gamification has the potential to reduce accessibility barriers by making mindfulness practices more structured and approachable for beginners. Many individuals struggle with traditional meditation due to a lack of clear goals or guidance, leading to frustration or disengagement. Gamification provides:

- **Built-in goals** – Reducing uncertainty and making mindfulness feel more intuitive.
- **Immediate feedback** – Allowing users to recognize progress and stay motivated.
- **Defined rules** – Simplifying mindfulness practice by providing a structured experience.
- **Challenges that match skill levels** – Aligning with Csikszentmihalyi's (1990) [25] Flow criteria, ensuring users remain engaged without feeling overwhelmed.

By leveraging gamification, mindfulness practices can become more accessible for those who struggle with traditional, unstructured meditation.

2.3. Immersive Technology as a Medium

Immersive technology provides an opportunity to make mindfulness more accessible by creating engaging experiences. Unlike meditation, which requires quiet dedicated spaces, or mindfulness apps which relies on smartphone devices, immersive environments offer a pre-setup space for mindfulness practice. This section explores how immersive technologies such as Virtual Reality (VR), Augmented

Reality (AR), and projection-based Mixed Reality (MR) have been used to facilitate mindfulness, with a particular focus on how they can improve accessibility beyond engagement alone.

By examining case studies from Tokyo, London, and New York, we explore the balance between engagement, accessibility, and mindfulness. In particular, this section highlights how projection-based systems provide an alternative to costly, individualistic mindfulness tools like VR, making immersive mindfulness more accessible in shared spaces such as offices, schools, and public environments.

2.3.1 Comparison of Immersive Technology

As Marshall McLuhan (1967) [37] famously stated “The medium is the message”, suggesting how the way a message is experienced changes depending on how it is experienced. Introducing immersive technology to mindfulness could shape how users engage with the practice. Three types of immersive technology will be explored in this research: Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR).

Virtual Reality (VR):

VR provides complete immersion through “goggles”, transporting the user into a full digital environment. Within the extended reality (XR) realm, VR has been the most researched tool for mindfulness. A study in 2020 by Seabrook et al., [38] explored the effectiveness of a VR app designed to enhance state mindfulness, showed positive results as participants reported that VR helped with focusing in the present-moment. The complete immersion through being completely surrounded by visual and audio are the main strengths of VR technologies. However, VR can be difficult, expensive and not so accessible for users with no prior exposure to these technologies. Additionally, a 2023 paper by Lundin et al. [39] identified health effects on VR interventions in mental health, stating how VR can cause “cybersickness, worsening of symptoms like anxiety, tiredness, dizziness, and back pain”. This study raises awareness to whether VR is an effective tool as a long term mindfulness intervention. For this research focusing on brief mindfulness and accessibility, VR might not be the most effective tool for this

concept.

Augmented Reality (AR):

AR is the technology of overlaying virtual elements into the physical world, allowing users to still be able to see and experience the real world. The study by Liu & Sutunyarak (2024) [40], found that participant's exposure to AR technology in museums found the whole experience to be more engaging and enjoyable. This engagement demonstrates AR's potential for integrating into mindfulness practices. For example, overlaying mindfulness elements like guided prompts could be one of the ways to integrate this technology into mindfulness practice. AR is commonly used through smartphones, making it more accessible compared to VR. However, its over-reliance on smartphones can be a source of significant distractions, undermining intervention designed to promote mindfulness. To avoid this, careful considerations must be taken to minimize distractions caused by the presence of smartphones. The motivation for this study started from my observations of over-use of smartphones and its distracting nature. Therefore, technologies tied to smartphones will be avoided in this study.

Mixed Reality (MR):

Although Mixed reality comes in many forms such as combining the strength of VR and AR to offer a seamless blend between virtual and physical world, this research will focus on interactive projection and immersive spaces as the primary focus of MR technology. To explore the pros and cons of this medium, the following sections will be about my auto-ethnography of immersive installations in Tokyo, London, and New York. Examining the various design elements and people's behavior, in order to understand if this tool can be used in mindfulness practices.

2.3.2 Observation Of The Public - Tokyo, London, and New York (Auto-Ethnography)

To better understand how the public reacts to immersive spaces, I've visited three immersive spaces in three different cities; Tokyo, London, and New York. The goal

was to observe how people from different cultures react to immersive spaces and discover any similarities and differences which can help guide our design process.

Tokyo - teamLabs

Within teamLab Planets, an immersive experience in Tokyo, visitors explore a series of rooms featuring its own digital installation and unique concepts designed to engage the senses. One particularly notable installation, “Floating in the Falling Universe of Flowers” (teamLab, 2016-2018) [41], invites visitors to “Lie down or sit still in the space and eventually your body floats and you dissolve into the artwork world”. The large, dark room is illuminated by a projection of flowers blooming and floating across the space, creating a meditative atmosphere. While the exhibit does not specify whether the aim was to encourage mindfulness, my observation revealed many visitors laying down and becoming immersed in the present-moment.

Other installations such as “Soft Black Hole - Your Body Becomes a Space that Influences Another Body” (teamLab, 2016-2018) [42] focus on engaging the sense of touch through a room filled with materials of different softness and feel. Similarly, “Drawing on the Water Surface Created by the Dance of Koi and People” (teamLab, 2016-2018) [43] encourages movement as visitors chase digital projected koi fish that respond to their footsteps in the water. These experiences, while offering potential to heighten mindfulness through senses, were ultimately disrupted by the usage of smartphones.

For many, including myself, documenting experiences through our smartphones, whether for memory or for social media has become a core habit. This shifts our objective from experiencing the moment, to taking photos and videos for keepsake. Despite this, “Floating in the Falling Universe of Flowers” teamLab, (2016-2018) [41] stood out as the most effective exhibit in fostering mindfulness. After taking photos, many visitors chose to relax in the space. Some closed their eyes, some discussed with their partners about the experience, and I noticed a faint floral scent which helped bring my awareness to the sense of smell.

In summary, teamLab Planets demonstrated that immersive technology has the potential to foster mindfulness, but several factors must be considered for it to be effective. One key takeaway is the importance of reducing smartphone usage



Figure 2.4 My Photograph of My Experience At “Floating in the Falling Universe of Flowers”

within immersive spaces, as it disrupts present-moment awareness not just for the user, but for others as well. Additionally, environmental factors like large crowds, noise pollution, and lack of privacy diminished the experience for me.

London - Outernet Londons

Situated in the bustling area of Tottenham Court Road, Outernet London is an open immersive space that allows visitors to freely walk in and out. Its accessibility allows for a unique experience that introduces the general public to immersive technology, breaking down barriers to this uncommon medium.

What stood out during my visit was Outernet’s strategy on maintaining public engagement to avoid the experience from going stale and losing its first-time novelty. In the installation, multiple artworks are shown on a rotation basis, ensuring a constant sense of renewal. These pieces are often unique from one another as they are works in collaboration with other artists. This approach not only sustains interest, but encourages visitors to return, knowing there’s always something new to discover.

During Christmas, a special installation featuring depth sensors enabled full-



Figure 2.5 My Photograph of Outernet London

body interaction. This allows visitors to play and interact with the digital world. This playful interactive experience highlighted the potential of immersive spaces as a place to encourage spontaneous engagement. However, similar to teamLab, Outernet also struggles with smartphone pandemics, where instead of fully immersing ourselves in the installation, many visitors including myself, instinctively take photos and videos. While mindfulness is probably not Outernet’s goal, the overuse of smartphones did diminish my “immersive” experience.

New York - Mercer Labss

Mercer Labs in New York offers another immersive experience designed to engage multiple senses. But what stood out to me was the spatial audio room, a space that encouraged mindfulness through sound.

Unlike the visually overwhelming installations at teamLab and Outernet, Mercer Labs’ spatial audio room eliminated visual elements. Without any visuals to capture, most visitors were seen focused on experiencing the sound. Experiencing the location of sound, the bass, and overall focusing on the present-moment experience. This minimalist approach allowed me to engage with the installation more fully, demonstrating how sometimes, less is more. By limiting sensory input,



Figure 2.6 Observation of Tools At Outernet (Depth Sensor)

Mercer Labs successfully created an environment where visitors could experience a level of immersion and mindfulness in a public setting.

Conclusion:

This analysis of my auto-ethnographic experiences at Tokyo's teamLab, London's Outernet, and New York's Mercer Labs revealed a common challenge: the overuse of smartphones in immersive spaces. Regardless of cultural context, visitors prioritized capturing content over fully immersing in the experience, which contradicts the core principles of mindfulness. Research has shown that merely holding a smartphone can disrupt focus, concentration, and mindfulness [44]. This highlights an accessibility issue in modern mindfulness design where many interventions depend on personal devices, reinforcing digital and financial divides.

Key takeaways for fostering mindfulness in immersive spaces include:

1. **Minimizing smartphone distractions** - Design elements in ways that make smartphone use impractical (e.g., spatial audio).
2. **Balancing playfulness and mindfulness** - Playful interactions can help enhance engagement, but they should be designed thoughtfully, or the experience could end up being mere entertainment.



Figure 2.7 Mercer Labs' Spacial Audio Space

3. **Refreshing the visuals** - Outernet's strategy of rotating artworks highlights the importance of keeping experiences fresh and novel to sustain long-term engagement.
4. **Reducing sensory overload** - As seen in Mercer Labs, removing visual stimuli can simplify the experience and help users focus on subtler senses like sound, encouraging deeper mindfulness.

2.4. Research Gap

While the benefits of mindfulness practices are well-documented, traditional practices remain inaccessible to many due to time constraints, the need for guidance, and the requirement of quiet, dedicated spaces. Modern solutions, such as mindfulness apps and VR experiences attempt to bridge this gap but as a result introduces new accessibility barriers of their own.

Immersive technologies have shown potential for enhancing engagement and present-moment awareness, however their application in mindfulness remains underexplored. Specifically, there is a lack of research on how Flow, gamification, and interactive system can create a low barrier and distraction-free mindfulness

experience. Existing mindfulness interventions often prioritize passive engagement rather than leveraging embodied, playful interactions as an entry point for beginners.

This research seeks to address these gaps by proposing *Moment*, an interactive, projection-based mindfulness system that combines immersive design, Flow principles, and gamification to offer an alternative entry point into mindfulness practice. By focusing on accessibility, engagement, and ease of use, this study contributes to the exploration of how mindfulness practice can be designed to be more inclusive for diverse users.

Chapter 3

Design Process

This chapter outlines the process of designing an immersive mindfulness system, covering each stage from ideation to prototype, testing and iterative development. It will include three rounds of user testing, with the second test focusing on comparing the designed intervention to a control.

3.1. Methodology

The methodology for designing and evaluating the interactive system *Moment* followed an interactive, user-centered design approach. The chapter goes through the preliminary survey which gives insights into the user needs, then validating design concepts, and measuring outcomes through each iterated prototype. Quantitative data were collected using the State Mindfulness Scale for Physical Activity (SMS-PA) as well as open-ended questionnaires used to collect qualitative data.

3.1.1 Design Concept - Preliminary Survey

To start, a preliminary survey was conducted, collecting responses from 18 students at Keio University’s Graduate School of Media Design. The data gathered from the survey helped inform and guide the design of the intervention. The initial goal was to determine whether a mindfulness intervention was necessary in their daily lives. Questions such as, Q2. “What are the main sources of stress in your life right now?” aimed to understand what mindfulness means to each person, whether they currently practice it, how they do so, and whether they believe an intervention in a school or work setting would be beneficial (see Appendix for survey questions). The results helped shape the goal of this research: to design

an intervention for (1) individuals with little to no prior mindfulness experience and (2) those who need to practice mindfulness within a short time frame.

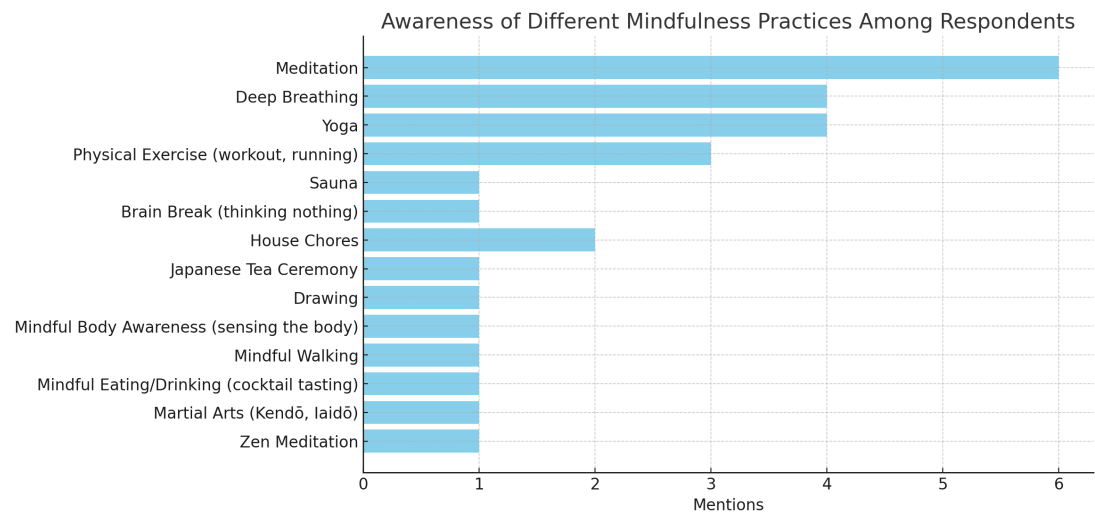


Table 3.1 Respondants Awareness of Mindfulness Practices

Q3, “What does ‘mindfulness’ mean to you?” and Q5, “What mindfulness practices are you aware of?” helped identify each person’s definition of mindfulness. The results showed all participants could identify at least one type of mindfulness practice, whether it’s formal practices like “Meditation,” “Deep breathing,” and “Doing Yoga,” or informal approaches like “Doing chores,” “Mindful eating,” and “Physical exercise.”

Q4, “In your opinion, can mindfulness practices affect stress? If so, how?” helped identify whether the respondent sees mindfulness as helpful against self-reported issues of stress reported in Q2. Answers like “Yes. The more you practice, the more aware you become in your everyday life,” “Probably, it would be nice to somehow reset yourself when you’re in stress,” and “Yes, it helps calm myself down and cope with panic attacks” showed how many respondents believe in the practice of mindfulness as a way to combat issues like stress.

However, answers like “No, because I might start overthinking,” “I guess so? It’s like stepping out of the self and current moment for a while, so you step out of the stressful situation too,” and “Maybe it can help us feel comfort... although I’ve never done it before” showed a belief in the practice but a lack of understanding

of the practice. This helped me understand the importance of guidance and a clear aim in mindfulness practice.

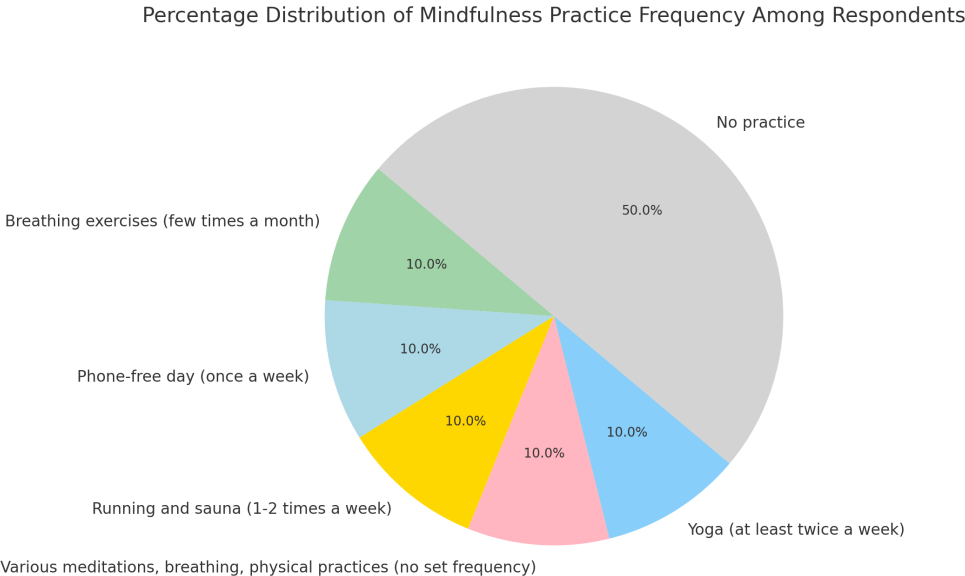


Table 3.2 Chart Showing Percentage of Mindfulness Practice

And perhaps not so shockingly, 50% reported “No practice” for Q6, “Do you currently practice mindfulness? If yes, what do you do, and how often?” While the other half practiced a form of mindfulness a few times a month or weeks. Linking the data back to Q1, “How would you rate your current stress levels?” showed an interesting connection. Respondents who reported “No practice” also showed higher stress levels, which can be clearly seen in the figure below.

This affirms the need for a mindfulness intervention, particularly for those who’ve never practiced mindfulness. Additional questions on whether respondents would be open to practicing mindfulness in a school or work setting showed that only 36.4% were open to the idea if a specific, quiet space was available. In contrast, 63.6% felt that school is not conducive to mindfulness due to factors like noise, crowding, potential interruptions, or a lack of privacy.

Summary: The survey findings revealed a significant gap between awareness of mindfulness practices and their actual adoption, with 50% of respondents not



Table 3.3 Correlation Between Mindfulness And Stress

engaging in any mindfulness activities and reporting higher stress levels. While participants recognized the potential benefits of mindfulness, their lack of understanding and experience with the practice underscored the need for guided interventions. This points to an opportunity to develop a novel intervention that is both accessible and practical for individuals with little to no prior experience, designed for use in noisy, shared, or time-constrained environments. Addressing these gaps offers the potential to make mindfulness more approachable and integrated into daily routines, paving the way for greater adoption and stress reduction.

3.2. Initial Design

1. Based on the literature summarized in sections 2.1.6 highlighted the importance of accessibility considerations. Virtual reality headsets and AR requiring setting up may not be suitable for users under time pressure, while traditional meditation may not be enticing for new users. Therefore, the first design and testing will focus on the usage of interactive projection to create an immersive and playful mindfulness experience. In section 2.3, public immersive technology allows for a sense of cooperation and play between people. 2. While 60% reported in the preliminary survey that they wouldn't be able to practice mindfulness at school, further testing needed to be validated whether a group mindfulness practice can be practiced at school, or if it's more effective to design a private experience at school or work setting. 3. Some meditation practices emphasize the use of sound such as the singing bowl associated with Buddhist mindfulness to aid with focus and as a gentle reminder to bring awareness back. This initial test aims to validate whether periodic sound enhances mindfulness through behavioral observation and feedback.

3.3. Validation Testing

Five participants took part in the testing simultaneously as one group. The focus was on observing the user's behavior when testing an interactive projection that mirrors the movement of the users. Three designs were made with minor

differences to each one. The aim was to validate the following:

Validation 1: Projections enhance playfulness and engagement. Validation 2: Group experiences effectively support mindfulness practice. Validation 3: Sound elements encourage participants to meditate

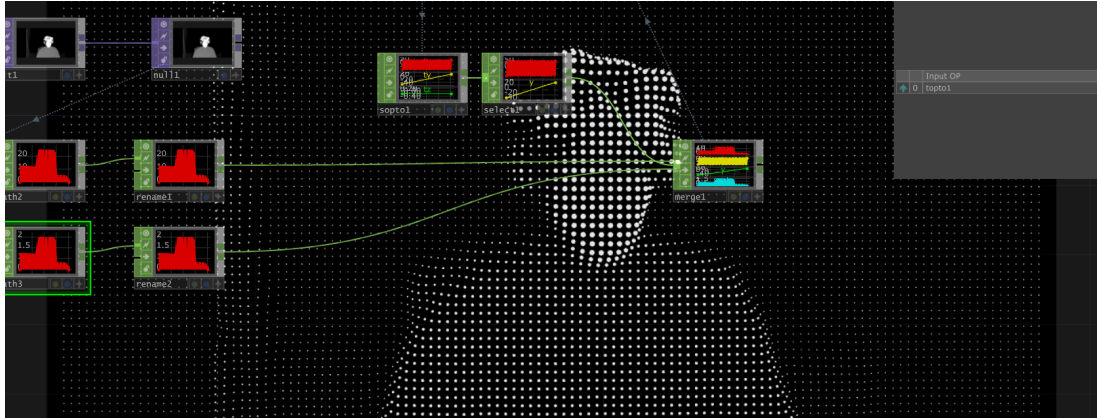


Figure 3.1 Prototyping interaction using TouchDesigner

3.3.1 Procedure & Structure

To begin, the participants were briefed to the concept of the research and the interaction system. The interaction was designed using TouchDesigner to mirror the user's body movement using a Kinect camera inspired by Milk's "The Treachery Of Sanctuary" (2012), aiming to encourage play and body movement. The unguided experience was structured to allow for free movement and time to reflect similar to meditation (Brown & Ryan, 2003), with periodic sounds of singing bowls to aid with focus. The participants were asked to interact with each experience freely for up to 5 minutes per experience. Observation of their behavior along with reports of their experience were used to validate the concepts.

3.3.2 Outcomes & Insights

Responses from open-ended interviews and observations of participants' behaviors were analyzed to form the following findings:

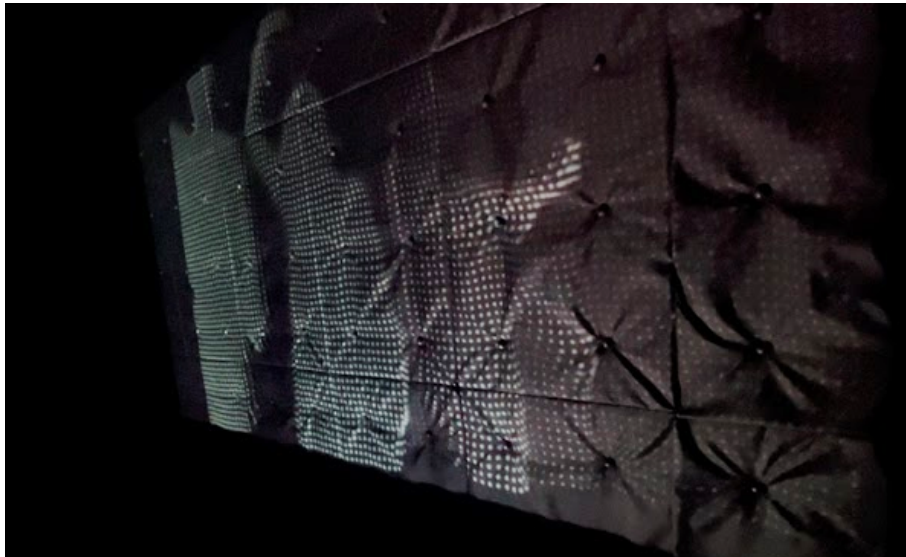


Figure 3.2 User testing: Mirrored interaction

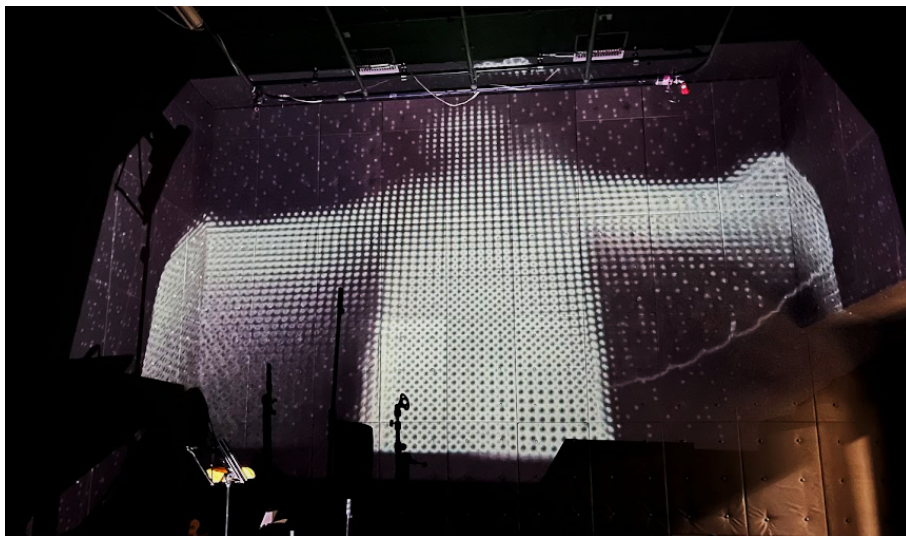


Figure 3.3 Enlarged projection with delayed feedback effect

Validation 1: Projections enhance playfulness and engagement.

Upon interacting with the projection, all users proceeded to move around, swinging their arms out of curiosity. The delayed feedback effect, which leaves trails of particles as users move (Figure 4), was favored by all the participants, describing it as the most “playful” out of the three interactions. This effect of immediate feedback satisfies one of Csikszentmihalyi (1990)’s conditions for achieving Flow. One factor that wasn’t considered during the design was awe and spectacle. During the third interaction, one participant suggested enlarging the projection by moving the projector back, making it 3 times the size of the users (Figure 5). This adjustment sparked sudden interest amongst previously disengaged participants, who began experimenting with movements. Participants were observed to move slowly to mimic a giant’s movement, while some moved faster to see how chaotic the projection can get. Whether this affects mindfulness requires further testing, however this sense of awe was shown to enhance engagement and playfulness.

Validation 2: Group experiences effectively support mindfulness practice.

Overall, the users did not report feeling “mindfulness” in any sense. Perhaps a clear structure or guidance to the experience could help with expectations of results (Csikszentmihalyi, 1990). Furthermore, this lack of guidance led to participants looking lost and confused as to their objectives. Bystander effect was also observed [45], where participants ‘took turns’ interacting. One person would step up to briefly interact, then step back, believing that their responsibilities were to interact a bit before letting the next person do their thing. Participants will also mimic the actions of previous users, reluctant to try something different from the group.

Indeed, it was reported afterwards that all five would’ve preferred a private experience to go through the experience by themselves without the pressure or observation from others, noting that they felt “awkward” or “lost” during the experience. “Uncomfortable feeling of having others watch you” was noted as one of the main

reasons why participants struggled to be mindful of the present moment. This aligns with Goffman’s Self-Presentation Theory (1959), where participants may want to project a desired image to others. Therefore, they may have felt self-conscious about how they were perceived and as a result, diverging their attentions from mindfulness (Bahar, V.S. 2024).

Thus, this brief experiment demonstrated that a group mindfulness experience within this context, was ineffective in helping participants to remain present and reflect on their thoughts and actions.

Validation 3: Sound elements encourage participants to meditate.

Sounds of periodic singing bowls were observed to have the least impact on the experience, as all participants reported that the sound used in this context didn’t help them feel ‘mindfulness’ in any way. However, it was suggested by some that a background ambience such as rain and white noise, or soothing background music could help them with practicing mindfulness.

3.3.3 Considerations & Motivations For Prototype 1

Prior to the test, my main aim was to help users feel a sense of present moment awareness of thoughts like meditation [4]. However, I overlooked how awareness comes in many forms such as awareness of breath, surroundings, sounds, and body movements. Participants reporting how seeing their body movement reflected in the projection helped them feel more aware of their body. While no participants reported feeling mindful, being aware of their physical actions can lead to mindfulness down the line [9].

3.4. Prototype 1

Based on the results from the previous test and feedback from the participants, the first iteration of the prototype was developed. The interactive system, made using TouchDesigner, detects the user’s hands using MediaPipe Plugin by Blankensmith, T., & Scott, D. (2023–present) (Figure 6). This initial prototype was designed with the four conditions for Flow (2.2.1) in mind: The activity must 1. Have a

built in goal, 2. Have immediate feedback, 3. Sets of rules, and 4. Challenges that match the user's skill level.

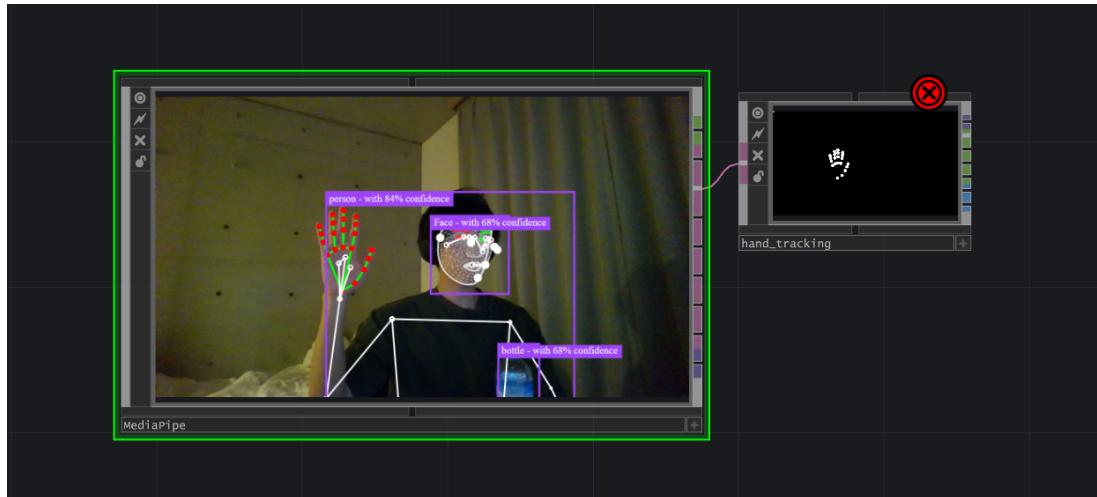


Figure 3.4 Hand Tracking Using MediaPipe Plugin In TouchDesigner

1. Built In Goal - Users will be informed of a goal, to calm the chaos and shape a beautiful form

The interaction begins with chaotic visuals, representing the user's unsettled mind. The goal is to transform this chaos into a beautiful lotus flower, symbolizing calm and focus. While visuals encourage users to reflect on their emotions, the primary goal is to provide users with a clear goal and a sense of reward upon completion of the practice.

2. Immediate Feedback - Visuals will respond to user's interactions in real-time

Expanding on the concept of controlling one's chaotic energy, the visuals will respond to the user's concentration, becoming calmer or more chaotic in real-time. This provides real-time feedback to enhance awareness of one's focus.

3. Sets Of Rules - Users will perform the 'Qi Ball' exercise to enhance body awareness

Just like how breathing is used to control focus, users will be guided to focus on the movements of their hands. Particularly focusing on the movements of "Qi Ball", an exercise inspired by QiGong practices. In this exercise, users imagine an invisible energy ball between their hands while moving the palms in and out and

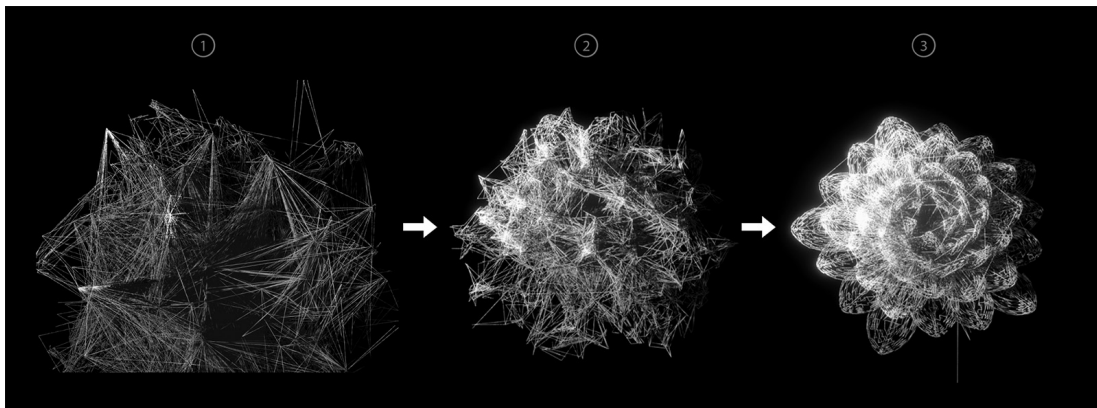


Figure 3.5 Visuals Of Chaotic Energy Turning Into A Lotus Flower

feeling the resistance or expansion of the ball. This mindful movement encourages awareness of bodily sensations, creating a meditative experience.

4. Skill-Matched Challenges - Users will have to find the right speed to progress

Users are encouraged to be mindful of their movements while performing the Qi Ball exercise. Slow, deliberate movements calm the chaotic visuals, while fast, rapid movements will return the visuals to its chaotic state. This creates a challenge for users to find and maintain their controlled pace.

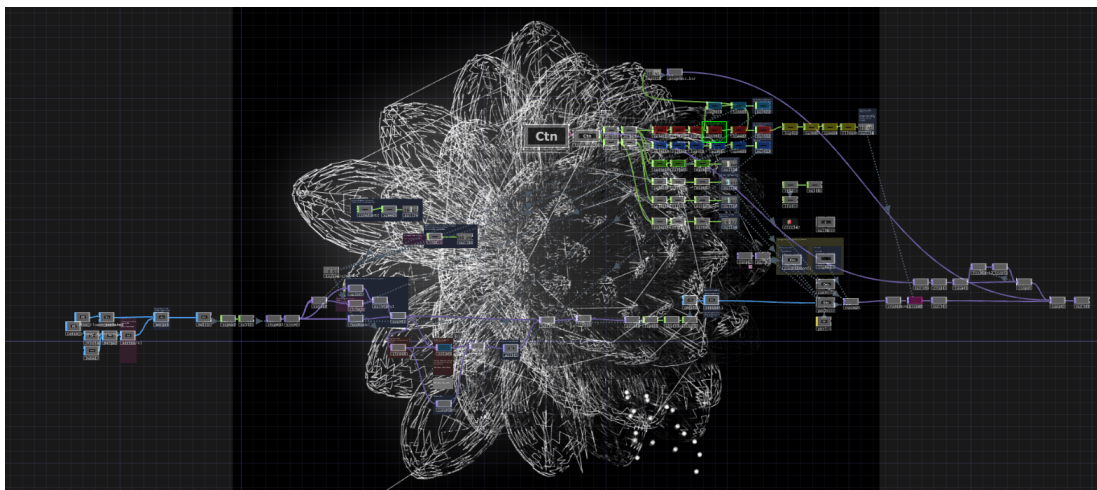


Figure 3.6 System Design In TouchDesigner

3.4.1 Prototype 1 User Test - Interaction

Four participants took part in this user test. The primary goal was to observe the user's behavior during interaction with the system. To focus on effectiveness of Flow-integrated interactions, projection and sound elements were excluded in this test. To start, participants were briefed about the goal of the interaction and were instructed to perform the Qi Ball exercise as the input. They were then situated in front of a laptop with the webcam detecting the hand movements.

3.4.2 Outcomes & Insights

“I can imagine playing (with this) for a long time...” - P1

Users reported feeling “calm and engaged” during the interaction, stating that hand movements were very interesting to them, suggesting the uniqueness and novelty of mindfulness interventions that use hand gestures as input along with technology. P3 stated “I like how I can see my hands in real time”, suggesting the effectiveness of displaying a hand tracker in the system. Without it, the lack of immediate feedback could lead to confusion. On the visual side, all participants were observed to be in awe when interacting with the system for the first time. This illustrates the effectiveness of novelty as a key to engagement, however, it also raises concerns to diminishing replayability, where novelty is lost in each interaction. This calls for considerations like changing visuals over periods of time to create that sense of replayability.

P3 mentioned how the chaotic visuals at the beginning helped them understand their current state of mind before engaging in the exercise. Surprisingly, none of the participants mentioned any considerations regarding colors when asked for feedback. White was chosen as it widely represents purity and calmness, and is a color that is generally considered neutral. While other colors have its own meaning, effects, and biases depending on the user, which could overpower other elements in this design like the visuals.

That being said, there were a lot of flaws when it comes to interactions of this first prototype. With the biggest being the confusion and lack of clarity in objective. Participants were observed to be confused and couldn't see clearly

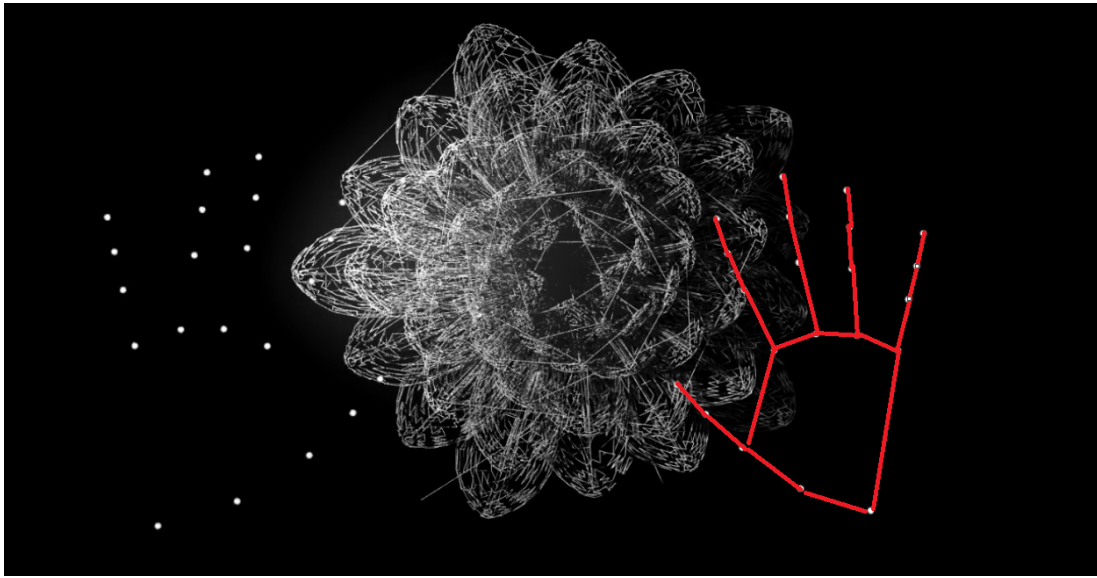


Figure 3.7 Visualizing Position Of Hands In Real-Time (Left: Actual Design, Right: Highlighted For Clarity)

enough how their slow deliberate movement leads to formation of the lotus flower. On multiple occasions, extra guidance and explanations were required to help participants interact with the system.

Lack of audio was also a common feedback amongst the participants. Many mentioned how introducing sound effects like “ambience music, background music, or ambient sounds like rain or wind” could help strengthen their practice. With P4 reflecting on how they often use calming music to help them with their meditation practice, suggesting the impact of audio which needs to be considered in the next prototype.

Finally, P1 brought up the speed of the interaction, and how it was too fast for them to feel any sort of positive effect. While the goal was to design an intervention for people in a hurry, this current interaction was too fast, taking an average of around 5 minutes to complete the practice. P1 brought up the idea of creating levels. This aligns with Csikszentmihalyi’s (1990) theory of flow where a skill-matched challenge is required for Flow to occur. Creating levels opens opportunities to change the visuals slightly for novelty and engagement, as well



Figure 3.8 Prototype 1

as creating a tailored system where users can pick which level of difficulty they want to use.

3.5. Prototype 2

Following user test 1, the interaction was refined and three new elements were introduced based on feedback from prototype 1.

Element 1: Progress bar

A bar that shows the progress of user's interactions inspired by games. The aim of the bar was to remove ambiguity of the goals based on feedback from testing of prototype 1, creating a clear structure of where the user is at and where they should go.

Element 2: 3 Levels Of Increasing Difficulty

Two more levels of the experience were created, each with its own unique visual as the reward. Each level provides increasing levels of difficulty fostering a state of flow, while allowing users to pick which level is suitable for them.

Element 3: Background Music & Sound Effects

Each stage has its own background music and a sound effect to indicate when the exercise is completed through a chime of a bell.

3.5.1 Prototype 2 User Test - Comparison

The aim of this test was to gather qualitative data on elements of the interaction for further improvements and quantitative data to compare the prototype against a guided meditation app Headspace. Twelve people took part in this user test, where half participated in the experimental group, while the other participated using Headspace as the control group.

3.5.2 Procedure

Before the test, participants were asked to fill in a pre-survey to determine their State Mindfulness Level 10 minutes prior to the test. The survey was the State Mindfulness Scale for Physical Activity by Cox, A., Ullrich-French, S., & French, B. (2016), with two additional questions added to determine effectiveness of Flow and gamification.

3.5.3 Outcomes & Insights

The evaluation of the third prototype highlighted several critical findings and areas for improvement. One of the key issues was that the progress bar caused stress for some participants. This element, intended to provide feedback on progress, instead created a sense of urgency that detracted from the intended mindfulness experience. Similarly, the gamification elements, while engaging, attracted too much attention and shifted the focus away from mindfulness.

Participants reported experiencing a pleasant feeling of “stopped thinking,” which differed significantly from the guided meditation experience. Guided meditation often encourages users to focus on their thoughts, which can be challenging. In contrast, *Moment* provided an alternative way to practice mindfulness through physical engagement and awareness of the body rather than the mind. This approach was well-received, offering a unique entry point into mindfulness practices.

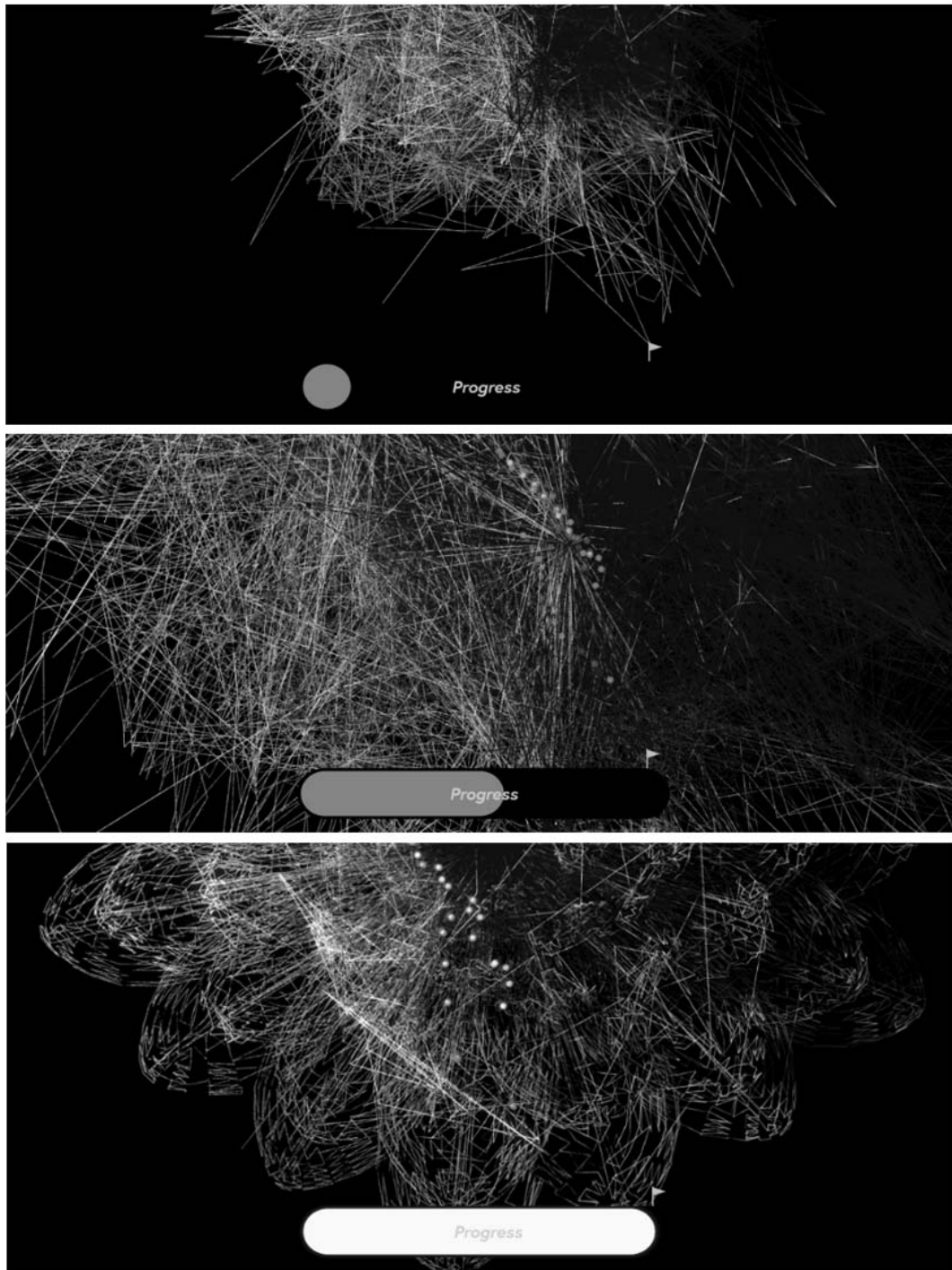


Figure 3.9 Progress Bar

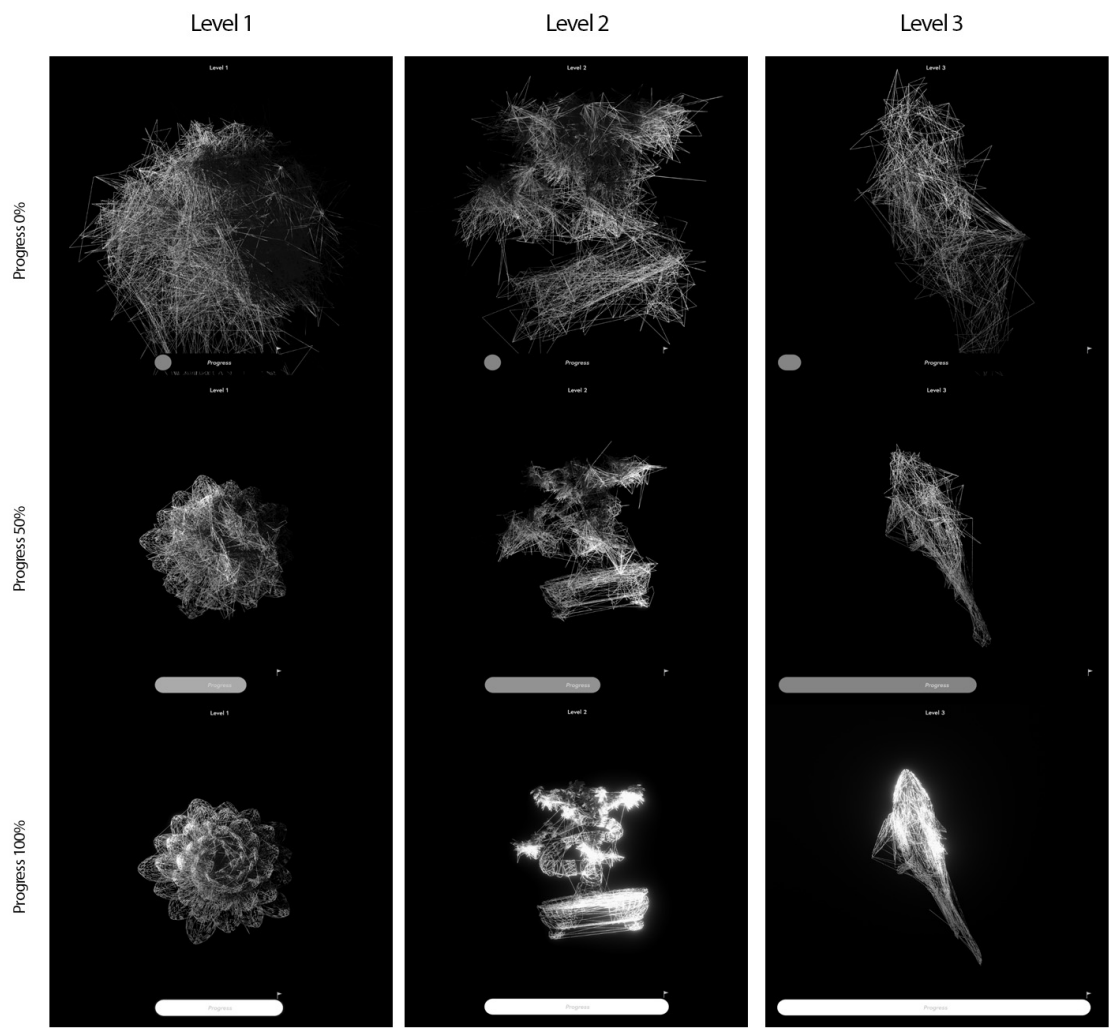


Figure 3.10 Overview of The 3 Levels



Figure 3.11 User Testing With Prototype 2

Background music was another notable success, with many participants stating that it helped them engage more effectively with the experience. However, technical issues arose with the sensors, particularly for Participant 4 (P4), who reported frustration and stress when the sensors failed to track accurately. Interestingly, Participant 3 (P3) interpreted the tracking inconsistencies as part of the challenge, embracing the difficulty and describing it as an effort to “find the sweet spot.”

Despite these challenges, all six participants successfully completed all three levels of the prototype and appreciated the increasing difficulty. Overall, the feedback was positive, with participants valuing the engaging and evolving nature of the experience. These insights were instrumental in shaping the final version of *Moment*.

3.6. *Moment*: A Playful Immersive Mindfulness Experience

The final outcome of this iterative process was *Moment*, a playful interactive experience designed to foster mindfulness. Developed using TouchDesigner, the

system encouraged users to focus on the present moment through engaging, body-driven interactions. The setup involved projecting the experience onto a wall in a dark, private room, with a camera connected to a laptop to track the user's hand movements.

Interactive System (TouchDesigner)

The system was built using TouchDesigner and the MediaPipe Plugin by Blankensmith, T., & Scott, D. (2023–present). This allowed for real-time hand tracking, which served as the primary input for controlling the interaction. The system utilized responsive visuals to create an immersive and engaging experience (see Appendix for full system diagram).

The diagram shows the overview of the system, which includes a main hub that controls the level switching, audio system, and performance optimization through cooking and uncooking (The act of turning on or off) specific levels.

Interface

The interface comprised a main projection where users could see their interactions and three buttons to allow movement between stages. This simple design aimed to make the experience intuitive and accessible, especially for first-time users.

Audio

Audio played a significant role in enhancing the experience. Each of the three stages had specific background tracks designed to align with the visuals and interactions. A chime indicated when the progress bar reached 100%, providing a satisfying sense of accomplishment.

Projection & Setup

The experiment took place in a private, darkened room. The projection was displayed on one of the walls, and a webcam positioned in front of the projection tracked the user's hand movements. A mouse was provided to allow users to switch between levels. Based on previous feedback about restricted movement in

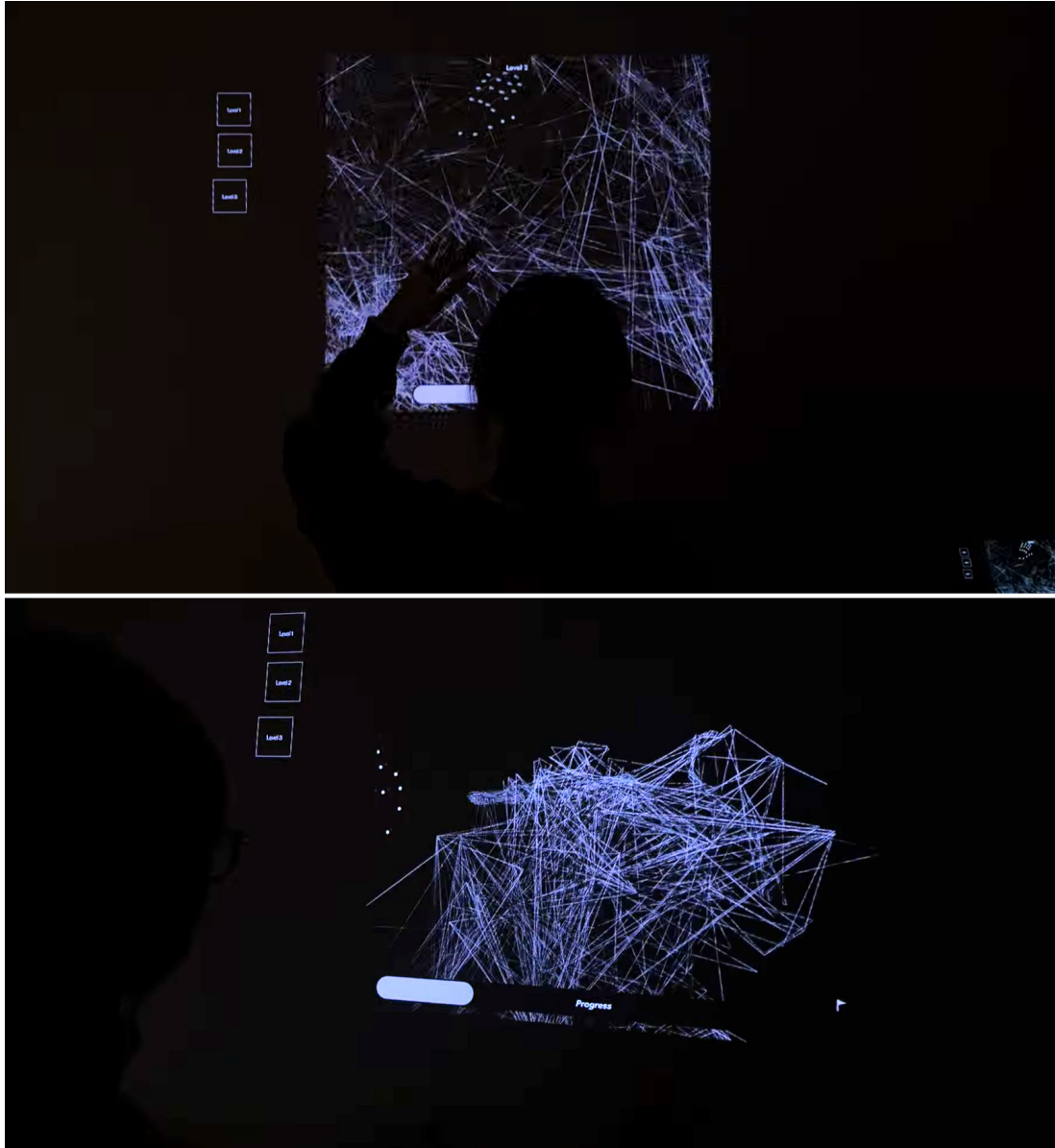


Figure 3.12 User Interaction With *Moment*



Figure 3.13 Overview of the TouchDesigner System

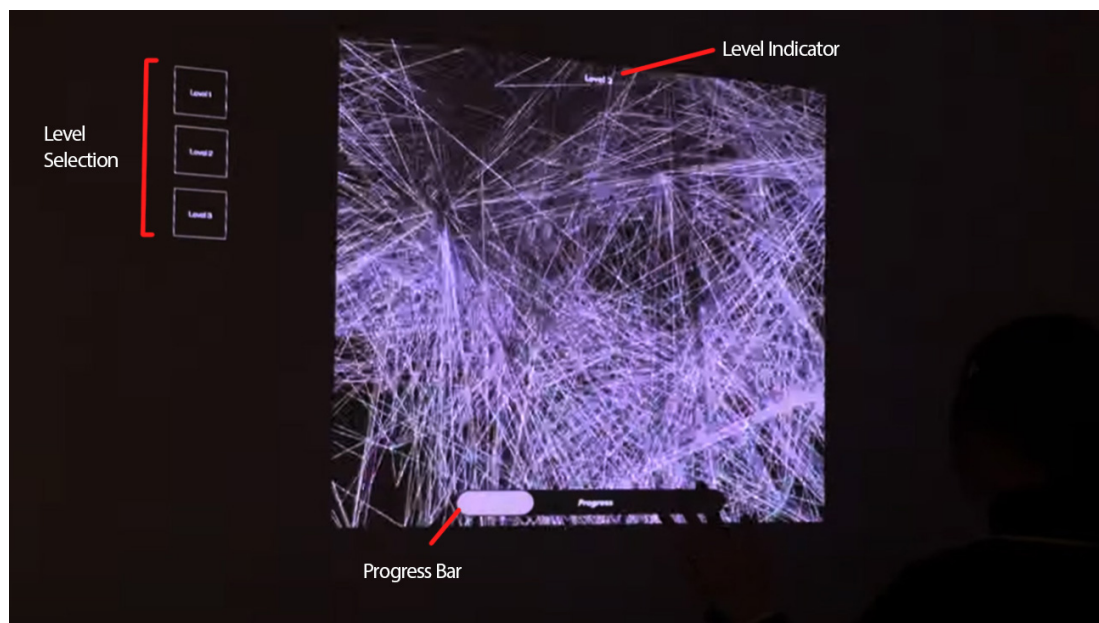


Figure 3.14 Interface of the experience

earlier prototypes, the room was cleared to provide ample space for free movement, fostering a more immersive and unrestricted experience.

3.6.1 Prototype 3 User Test

The third prototype was tested to evaluate whether the improved elements enhanced play and mindfulness. Both qualitative and quantitative data were collected using the same methods as the previous test.

Observing Movement Behavior

Compared to Prototype 2, participants had no restrictions on their movements during the briefing. In earlier tests, participants were instructed to perform specific Qi Ball movements, which some found limiting. This time, participants were briefed on the Qi Ball movement as an example of slow, deliberate action but were encouraged to perform any movements they preferred.

The results of this increased freedom were mixed. On the positive side, the lack of restrictions allowed participants to explore the interaction more freely, which some found liberating. However, others reported confusion and a lack of clarity regarding their goals. This aligns with principles of Flow, where clear objectives are necessary to maintain focus and engagement. The absence of detailed instructions left some participants feeling lost and even stressed.

Sensor tracking issues persisted, frustrating certain participants. P4 expressed dissatisfaction with the inconsistent tracking, while P3 interpreted the glitches as an intentional part of the challenge, demonstrating resilience and determination to “find the sweet spot.”

Despite these challenges, the prototype’s three levels were well-received. All participants completed the experience and noted that the increasing difficulty added to their enjoyment and sense of accomplishment. The iterative improvements led to a more engaging and dynamic mindfulness experience, providing valuable insights for further development.

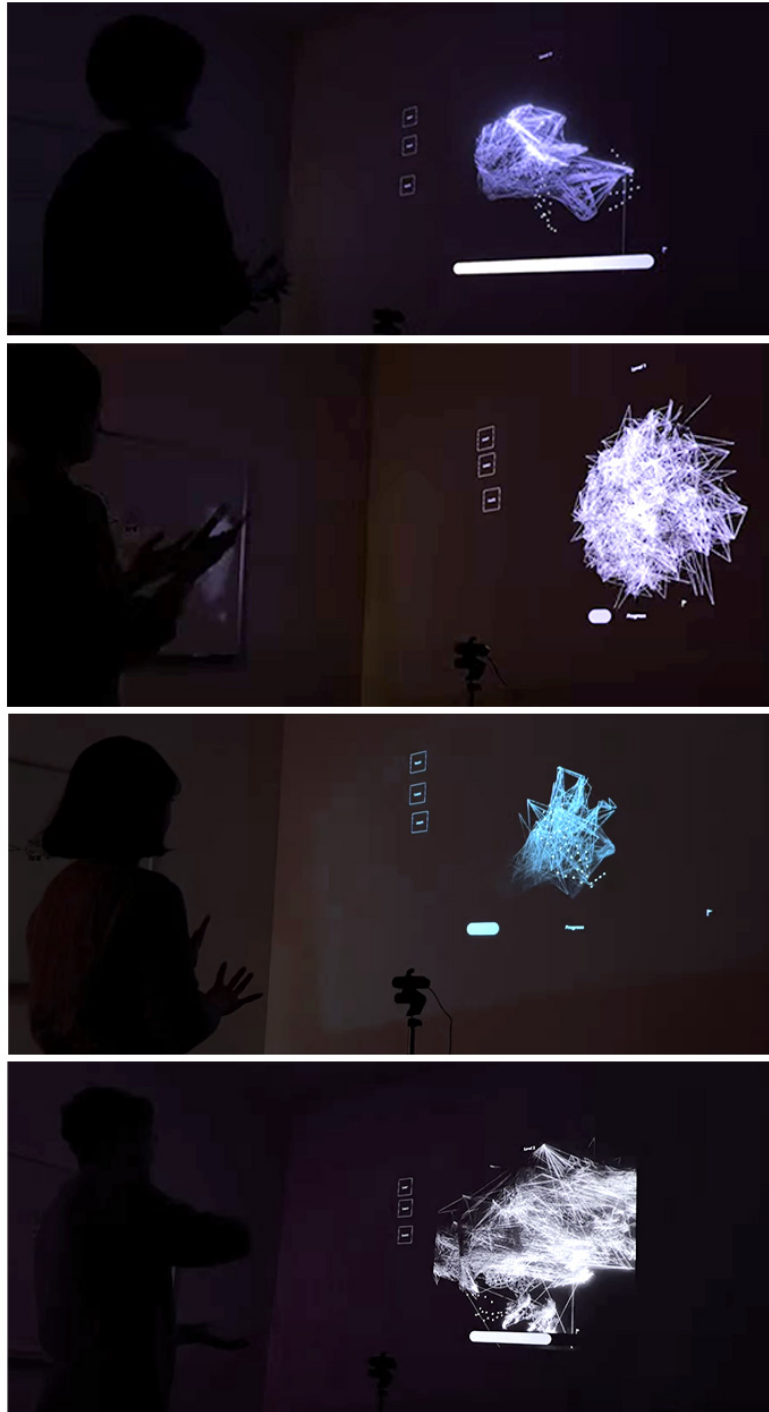


Figure 3.15 Participants Demonstrating Hand Movements

3.7. Conclusion of Design

To summarize, the iterative design process of *Moment* highlights the key to developing an interactive system that balances mindfulness with playfulness and immersive technology. Through 3 rounds of user testings, key insights were gathered to refine the experience—emphasizing the importance of clear goals, real-time feedback, and the integration of audio-visual elements to foster engagement and flow. While challenges such as tracking inconsistencies and sensor errors, the final prototype demonstrated a novel approach to mindfulness by shifting focus from cognitive meditation to bodily awareness and playful interaction. This process showcase the potential of immersive systems like *Moment* to provide a more accessible and enjoyable mindfulness experiences.

Chapter 4

Evaluation

After design and testing, this chapter will focus on evaluating the results.

- 1) First, looking at effectiveness of prototype 2 as an immersive mindfulness intervention compared to guided meditation app Headspace.
- 2) Then evaluate the final outcome *Moment* and its effectiveness as a novel, playful mindfulness intervention. The study evaluated mindfulness outcomes based on the State Mindfulness Scale for Physical Activity (SMS-PA), behavioral observations, and participant feedback.

4.1. Methodology

To evaluate the effectiveness of our design, we will focus on the following research questions. Questionnaires based on the State Mindfulness Scale for Physical Activity (SMS-PA) [46] were used to gather quantitative data, while open-ended interviews provided qualitative data.

1. **Research Question 1:** How does an interactive, gamified mindfulness intervention affect state mindfulness (thoughts, emotions, and body) compared to guided meditation?
2. **Research Question 2:** How does the perceived impact of mindfulness practices differ between interactive and traditional approaches?
3. **Research Question 3:** How do Flow principles and gamification in an interactive mindfulness intervention enhance the overall experience and mindfulness outcomes?

4.2. State Mindfulness Scale For Physical Activity (SMS-PA)

There's two ways of measuring mindfulness; trait and state. Trait mindfulness refers to your personalities and characteristics, factors that are part of you and are difficult to change [47]. On the contrary, state mindfulness measures the present-moment awareness at that specific time. Measuring how aware the individual is of their thoughts, their emotions, and their ability to stay present when distractions arises. The SMS-PA was used to measure state mindfulness, through pre and post surveys. Key areas assessed included:

- Awareness of thoughts and their transience.
- Awareness of emotions and their fluctuations.
- Awareness of physical sensations and body engagement.

Additionally, two extra questions were added, 1. "I felt fully focused on the task or moment" to measure flow state, and 2. "I found the activity playful and enjoyable" to measure levels of playfulness.

4.3. Evaluation of User Testing 2 - Comparison Experiment

In testing of prototype 2, a total of 12 participants were divided into two groups:

- **Experimental Group:** 6 participants engaged with the interactive system *Moment*.
- **Control Group:** 6 participants practiced guided meditation using Headspace.

Participants were students from Keio University's Graduate School of Media Design.

4.3.1 Experiment Procedure

Participants completed a pre-intervention SMS-PA survey 10 minutes before the experiment to establish baseline mindfulness levels. The intervention lasted from 10 minutes, followed by a post-intervention SMS-PA survey and a semi-structured interview (see Appendix for the interview questions).

- **Experimental Group:** Participants interacted with the *Moment* system, which used hand-tracking and immersive visuals to engage users in a gamified mindfulness practice.
- **Control Group:** Participants engaged in a guided mindfulness meditation session via the Headspace app.

4.3.2 Results and Analysis - Research Question 1

1. RQ1: How does an interactive, gamified mindfulness intervention affect state mindfulness (thoughts, emotions, and body) compared to guided meditation?

Participants in the control group reported a greater increase in thought awareness: “I noticed thoughts come and go.” Showing an improvement of +2.00 on the mean change, while the experimental group showed +0.33, indicating meditation’s superiority when it came to being aware of thoughts. However, the experimental group showed +2.50 and +2.67 for “I focused on the movement of my body” and “I felt present in my body” respectively. One participant reflected, “I kept focusing on my hands and movements instead of my thoughts.” This data and observation suggests that interactive elements, while engaging, shifted focus from thought awareness, and in this case into body awareness, which is another form of mindfulness.

In terms of overall state mindfulness levels, the SMS-PA questionnaire measured two categories of mindfulness: Mindfulness of the Mind (Q1–6) (Awareness of thoughts, emotions, and mental patterns), and mindfulness of the Body (Q7–12) (Awareness of bodily sensations, movement, and physical presence). The meditation group demonstrated better improvements in mindfulness of the mind compared to the experimental group, which remained the same or declined. While

Differences In Pre And Post Data						
	Experimental Pre Mean	Experimental Post Mean	Experimental Change	Meditation Pre Mean	Meditation Post Mean	Meditation Change
1. I was aware of different emotions that arose in me.	2.67	2.50	-0.17	2.67	2.67	0.00
2. I noticed pleasant and unpleasant emotions.	2.67	2.83	0.17	2.50	2.50	0.00
3. I noticed pleasant and unpleasant thoughts.	1.83	1.33	-0.50	2.33	3.00	0.67
4. I noticed emotions come and go.	1.83	2.67	0.83	1.67	2.50	0.83
5. I noticed thoughts come and go.	2.00	2.33	0.33	1.50	3.50	2.00
6. It was interesting to see the patterns of my thinking.	2.33	2.17	-0.17	2.50	2.83	0.33
7. I focused on the movement of my body.	1.50	4.00	2.50	1.33	2.83	1.50
8. I felt present in my body.	1.33	4.00	2.67	1.83	3.33	1.50
9. I listened to what my body was telling me.	2.33	2.83	0.50	1.67	2.33	0.67
10. I was aware of how my body felt.	2.67	3.33	0.67	1.50	2.83	1.33
11. I noticed the sensations in my body.	2.17	3.50	1.33	1.67	3.33	1.67
12. I was in tune with how hard my muscles were working.	0.83	3.33	2.50	0.67	2.33	1.67
13. I felt fully focused on the task or moment.	1.67	4.00	2.33	2.50	3.00	0.50
14. I found the activity playful and enjoyable.	2.17	4.00	1.83	1.83	3.67	1.83

Differences In Mean						
	Experimental Pre Mean	Experimental Post Mean	Experimental Change	Meditation Pre Mean	Meditation Post Mean	Meditation Change
1. I was aware of different emotions that arose in me.	2.67	2.50	-0.17	2.67	2.67	0.00
2. I noticed pleasant and unpleasant emotions.	2.67	2.83	0.17	2.50	2.50	0.00
3. I noticed pleasant and unpleasant thoughts.	1.83	1.33	-0.50	2.33	3.00	0.67
4. I noticed emotions come and go.	1.83	2.67	0.83	1.67	2.50	0.83
5. I noticed thoughts come and go.	2.00	2.33	0.33	1.50	3.50	2.00
6. It was interesting to see the patterns of my thinking.	2.33	2.17	-0.17	2.50	2.83	0.33
7. I focused on the movement of my body.	1.50	4.00	2.50	1.33	2.83	1.50
8. I felt present in my body.	1.33	4.00	2.67	1.83	3.33	1.50
9. I listened to what my body was telling me.	2.33	2.83	0.50	1.67	2.33	0.67
10. I was aware of how my body felt.	2.67	3.33	0.67	1.50	2.83	1.33
11. I noticed the sensations in my body.	2.17	3.50	1.33	1.67	3.33	1.67
12. I was in tune with how hard my muscles were working.	0.83	3.33	2.50	0.67	2.33	1.67
13. I felt fully focused on the task or moment.	1.67	4.00	2.33	2.50	3.00	0.50
14. I found the activity playful and enjoyable.	2.17	4.00	1.83	1.83	3.67	1.83

Table 4.1 Data On Comparison of Experimental Group with Meditation Group

both groups improved in mindfulness of the body, the experimental group exhibited stronger gains, particularly in Q7, Q8, and Q12.

This indicates that while the meditation intervention enhanced participants’ awareness of thoughts and mental patterns, the experimental intervention was more effective in promoting awareness of bodily sensations and movement. Which is better may depend on the preference of the users, but in a true mindfulness sense, the prototype lacked the ability to evoke reflection of thoughts. With many participants commenting how they “... Wasn’t thinking of anything” (P6).

While, in a sense, this isn’t a true meditative experience, many found this loss of thoughts to be pleasant. For example, Participant 3 (P3) mentioned how they were stressed about tooth pain throughout the day, but during the user testing, they reported completely forgetting the dental issues and associated pain. Although this relief was temporary, it highlights the intervention’s ability to create a momentary sense of detachment from stress and physical discomfort, offering participants a brief respite from their daily concerns.

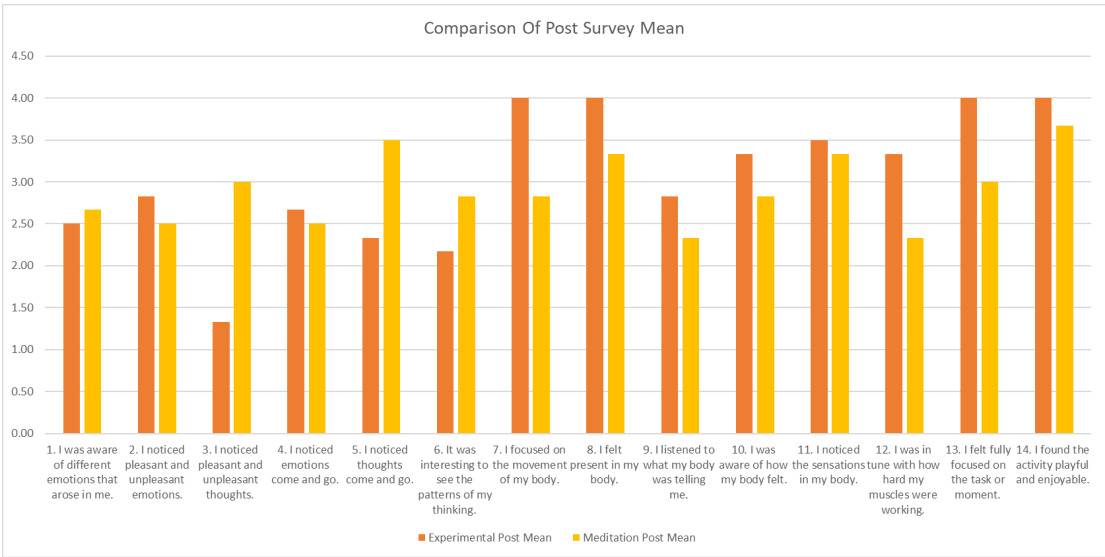


Table 4.2 Graph Showing Comparison of Mean Between 2 Groups

2. RQ2: How does the perceived impact of mindfulness practices differ between interactive and traditional approaches?

The perceived impact of mindfulness practices varied significantly between the control group and the experimental group. Participants in the control group described their experience with Headspace as calming, predictable, and mentally restorative. One participant noted, “It felt natural to focus on my breathing and let thoughts go,” highlighting the simplicity and effectiveness of traditional mindfulness approaches. However, participants also emphasized the need for a quiet and private environment to practice effectively. For example, one individual shared, “I wouldn’t do this at work—it needs a private, silent space.” This suggests that while guided meditation is highly effective, it may not easily integrate into noisy or busy settings like schools or workplaces.

Conversely, participants in the *Moment* group found the interactive intervention novel, playful, and engaging. Many participants highlighted the motivational aspects of the gamified feedback, describing the experience as both calming and stimulating. One participant commented, “It felt fun and calming at the same time,” while another reflected, “The interaction made me forget I was meditating, but I felt focused in a different way.” However, the experimental group also encountered challenges, such as technical limitations and system responsiveness, which occasionally disrupted their experience. For instance, one user remarked, “I got frustrated when I had to keep moving for it to work.” Despite these challenges, several participants noted that the system could be practical for use in schools or workplaces if the setup were simplified. One participant suggested, “If it was easier to use, I’d do this during a break at school to reset.”

These findings reveal that while traditional mindfulness excels in mental relaxation, the interactive system offers unique benefits such as engagement, motivation, and novelty. However, improvements to the system’s usability and technical performance are necessary for broader adoption in real-life settings.

3. RQ3: How do Flow principles and gamification in an interactive mindfulness intervention enhance the overall experience and mindfulness outcomes?

The use of Flow principles and gamification in the *Moment* system played a key role in enhancing user engagement and motivation. Several participants described experiencing moments of flow, where they became deeply immersed in the activity. One participant remarked, “I lost track of time because I was so

focused on moving the object,” while another shared, “It felt rewarding when I saw the visuals match my movements—it pulled me in.” These comments highlight how responsive feedback and interactivity can create a sense of accomplishment, which aligns with the principles of flow.

However, technical limitations occasionally disrupted this state of flow. Some participants expressed frustration when system responsiveness failed to match their actions. For instance, one participant said, “I felt punished when I couldn’t get it to work perfectly—it took me out of the experience.” This suggests that achieving flow in interactive mindfulness systems requires seamless and intuitive interactions to prevent frustration.

Gamification elements, such as visual rewards and animations, also influenced participants’ experiences. Users appreciated the motivational aspect of these elements, with one participant stating, “Seeing the object bloom made me want to slow down and focus.” This gamified feedback encouraged users to engage more deeply with the activity. However, some participants noted that the gamified approach shifted their focus away from mindfulness and toward task completion. One participant reflected, “I was more focused on finishing the task than on my breathing or thoughts.”

In summary, the incorporation of Flow principles and gamification enhanced engagement and created moments of immersive focus. However, the system sometimes prioritized interactivity over mindfulness, particularly in terms of thought awareness. Future iterations of the *Moment* system should aim to balance gamification with mindfulness goals by refining the flow state experience and minimizing task-oriented distractions.

4.3.3 Key Takeaways

The findings reveal distinct differences between the two approaches to mindfulness. The control group using Headspace excelled at fostering thought mindfulness, as participants reported greater awareness of their thoughts and emotions. In contrast, the experimental group using *Moment* demonstrated strengths in physical and emotional engagement, with users responding positively to interactive feedback and gamification as an alternative entry point into mindfulness.

To enhance its effectiveness, future iterations of *Moment* should improve on:

- **System Responsiveness** – Ensuring a seamless immersive experience by minimizing technical disruptions.
- **Balance Between Gamification and Mindfulness** – Maintaining engagement while preserving mindful awareness.
- **Simplification** – Enhancing usability to make the system more practical for schools, workplaces, and public spaces where accessibility is key.

However, *Moment* also faced challenges, particularly in technical limitations and distractions, which at times disrupted the overall mindfulness experience. Some participants reported difficulty maintaining focus due to system responsiveness issues, while others noted that the gamified elements sometimes shifted their attention toward task completion rather than being aware of the present-moment.

Chapter 5

Conclusion

In this research, we went through the design, testing, and evaluation of the interactive system *Moment*, an interactive system aimed at rethinking mindfulness accessibility through immersive and playful design.

The design and evaluation of *Moment* demonstrated the potential of immersive technology and gamification to re-imagine mindfulness practices. By shifting the focus from traditional, cognitively demanding meditation to engaging, body-based interactions. *Moment* provided an alternative pathway to mindfulness that addresses barriers related to accessibility, engagement, and ease of use.

The findings highlight the potential of immersive technology and gamification in lowering the barriers to mindfulness practice, particularly for individuals who struggle with conventional methods due to time constraints, inexperience, or other personal barriers. Unlike traditional mindfulness practices that often rely on stillness and mental discipline, *Moment* introduces an active, sensory-driven approach that makes mindfulness more approachable, intuitive, and enjoyable.

This research contributes to the growing body of work on interactive mindfulness interventions, demonstrating how Flow principles and gamified design can serve as accessibility tools rather than just engagement mechanisms. By bridging the gap between mental well-being and interactive design, this study proposes a new direction for making mindfulness inclusive to a wider demographic.

5.0.1 Practical Applications

Moment has practical applications across various shared spaces, making mindfulness more accessible beyond individual practice.

- **In Schools** - *Moment* could serve as a quick reset tool for students, helping them regain focus without requiring lengthy, structured meditation sessions.

- **In Workplaces** - *Moment* provides a low-effort stress-relief alternative, allowing employees to practice mindfulness without disrupting their schedules.
- **In Public Installations** - Similar to Tokyo's teamLab or Outernet London, a public mindfulness experiences could introduce mindfulness to broader audiences who may never engage with traditional meditation.

By addressing time constraints, digital divides, and accessibility barriers, *Moment* demonstrates how immersive technology can democratize mindfulness, offering a more inclusive alternative to traditional mindfulness interventions.

5.1. Limitations & Future Works

While the study provides promising insights, several limitations need to be addressed.

1. Limited Age Range of Participants

The participants for this research were students ages between 22-28, which may limit the generalizability of the findings. Future studies should consider testing the system with people of all ages and demographics, to fully observe how each group deals with the system and concept.

2. Longitudinal Studies

Conducting long-term studies is essential to understanding the sustained impact of playful mindfulness interventions on user behaviors. These studies would help determine whether users are likely to independently return to or integrate the system into their routines over time. By observing user engagement, retention rates, and behavioral changes across extended periods, researchers can assess the long-term effectiveness and adaptability of *Moment*. Such insights would be invaluable for refining the system to foster lasting mindfulness habits and deeper emotional well-being.

3. Practical Testing

Testing *Moment* in various environments like corporate workplaces, public spaces, or even home settings could help evaluate its adaptability across different demo-

graphics. The current setup required the experimenter's presence, limiting accessibility and usability. Future studies could focus on developing self-contained systems that allow users to interact with *Moment* autonomously in publicly accessible spaces available at all times.

This project originated from observing the lack of dedicated meditative spaces in schools and workplaces. Positive participant feedback suggests the potential of a playful, immersive approach to mindfulness, not only in raising awareness but also in offering a practical and novel solution. By addressing modern challenges in mental well-being with immersive technology, *Moment* serves as a foundation for future research integrating mindfulness, play, and technology to create more impactful interventions.

4. Philosophical Reflections

The research invites reflection on the role of technology in reshaping mindfulness practices. While traditional methods emphasize introspection and simplicity, the use of interactive systems like *Moment* demonstrates that technology can complement these values by making mindfulness more dynamic and inclusive. However, this evolution raises important questions: Does the gamification of mindfulness dilute its essence, or does it simply provide a modern reinterpretation?

By encouraging users to reconnect with their bodies and the present moment through playful, technology-driven interactions, *Moment* challenges conventional notions of mindfulness. It offers a pathway that feels relevant in a world increasingly defined by distraction and technology. As this field evolves, designers must navigate the fine line between leveraging technology to enhance mindfulness and ensuring that the medium itself does not become a source of distraction.

5.2. Final Thoughts

The aim for *Moment* was to be more than a playful mindfulness intervention. It is a stepping stone towards rethinking how we approach mental well-being in the digital age. Hopefully, it serves as a reminder that mindfulness does not have to be a solitary, rigid practice but can be dynamic, engaging, and deeply personal.

By merging the principles of Flow, gamification, and immersive design, this

research paves the way for future innovations that make mindfulness accessible, impactful, and enjoyable for all.

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Appendices

- A. State Mindfulness Scale for Physical Activity (SMS-PA)
- B. Survey Based on SMS-PA
- C. Preliminary Survey Questions & Structure
- D. Open-ended Interview For Qualitative Data
- E. TouchDesigner System of *Moment*

We are interested in what you just experienced during [insert activity]. Please indicate how much you experienced each of the following by circling one number.						
		Not at all	A little	Moderately	Quite a bit	Very much
1.	I was aware of different emotions that arose in me.	0	1	2	3	4
2.	I noticed pleasant and unpleasant emotions.	0	1	2	3	4
3.	I noticed pleasant and unpleasant thoughts.	0	1	2	3	4
4.	I noticed emotions come and go.	0	1	2	3	4
5.	I noticed thoughts come and go.	0	1	2	3	4
6.	It was interesting to see the patterns of my thinking.	0	1	2	3	4
7.	I focused on the movement of my body.	0	1	2	3	4
8.	I felt present in my body.	0	1	2	3	4
9.	I listened to what my body was telling me.	0	1	2	3	4
10.	I was aware of how my body felt.	0	1	2	3	4
11.	I noticed the sensations in my body.	0	1	2	3	4
12.	I was in tune with how hard my muscles were working.	0	1	2	3	4

Scoring: State Mindfulness of the Mind - Items 1 – 6
 State Mindfulness of the Body – Items 7-12

Figure E.1 State Mindfulness Scale for Physical Activity (SMS-PA) based on Tanay and Bernstein's (2013)

What was your experience like over the last 10 minutes?

Please rate how much each statement matches your experience.

* Indicates required question

1. 1. I was aware of different emotions that arose in me. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

2. 2. I noticed pleasant and unpleasant *emotions*. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

3. 3. I noticed pleasant and unpleasant *thoughts*. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

4. 4. I noticed *emotions* come and go. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

5. 5. I noticed *thoughts* come and go. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

6. 6. It was interesting to see the patterns of my thinking. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

7. 7. I focused on the movement of my body. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

8. 8. I felt present in my body. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

9. 9. I listened to what my body was telling me. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

10. 10. I was aware of how my body felt. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

11. 11. I noticed the sensations in my body. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

12. 12. I was in tune with how hard my muscles were working. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

13. 13. I felt fully focused on the task or moment. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

14. 14. I found the activity playful and enjoyable. *

Mark only one oval.

0 1 2 3 4

Not ☐ ☐ ☐ ☐ ☐ Very Much

Mindfulness

Please write whatever comes to mind! There are 9 questions.

* Indicates required question

1. 1. How would you rate your current stress levels? *

Mark only one oval.

1 2 3 4 5 6 7 8 9 10
Very ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very Stressed

2. 2. What are the main sources of stress in your life right now? *

3. 3. What does 'mindfulness' mean to you? *

4. 4. In your opinion, can mindfulness practices affect stress? If so, how? *

5. 5. What mindfulness practices are you aware of? *

6. 6. Do you currently practice mindfulness? If yes, what do you do, and how often? *

7. 7. When you feel like you want to practice mindfulness but can't, what stops you? *

8. 8. Can you imagine practicing mindfulness at school? If yes, what would you do? If not, why not? *

9. 9. If there were a mindfulness space on campus, what features would make it most appealing to you (e.g. quiet space, guided sessions, interactive elements)? *

Open-ended questions:

1. Were you focusing on — Was it your thoughts, body?

Aim: To identify which aspect of mindfulness participants were aware of, in order to determine if the intervention successfully guides users to its intended awareness.

2. What challenges, if any, did you experience during the practice?

Aim: To uncover unforeseen issues, or cognitive barriers which participants could face during the testing.

3. Would you do this at school or in a work setting routinely?

Aim: To assess the practicality of integrating the intervention into real-life scenarios and to receive feedback on how that can be done effectively.

4. How did you feel before and after the mindfulness activity?

Aim: To measure impact of intervention and observing how it was done.

5. What was your overall experience. Any thoughts?

Aim: To gather qualitative feedback on user satisfaction, responses, and suggestions for improvement.

Figure E.2 Open-ended Interview For Qualitative Data

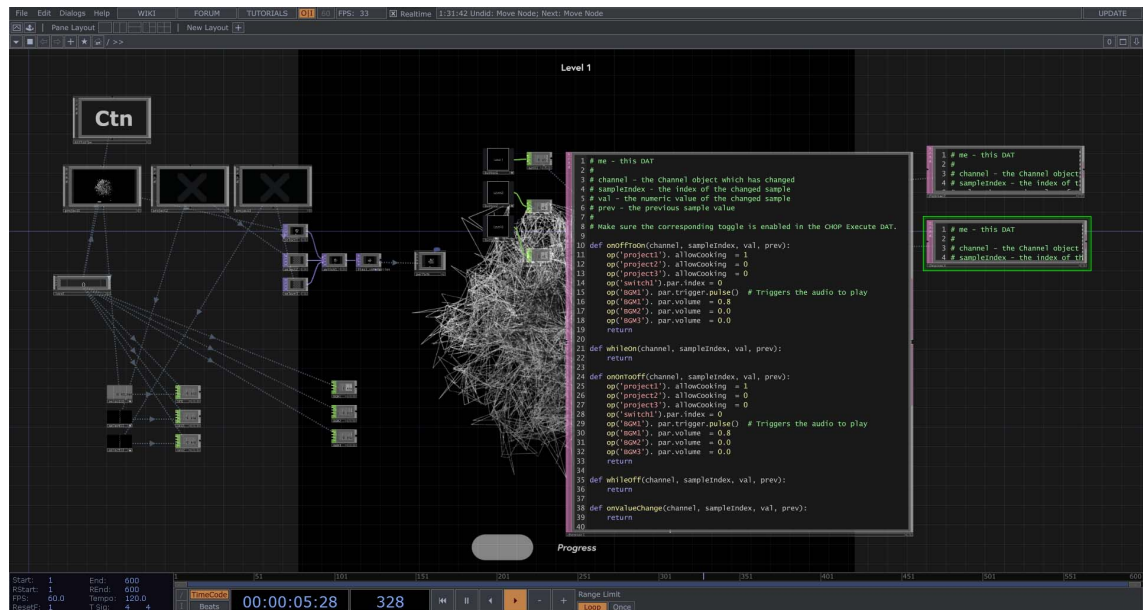


Figure E.3 *Moment* TouchDesigner System - Outer

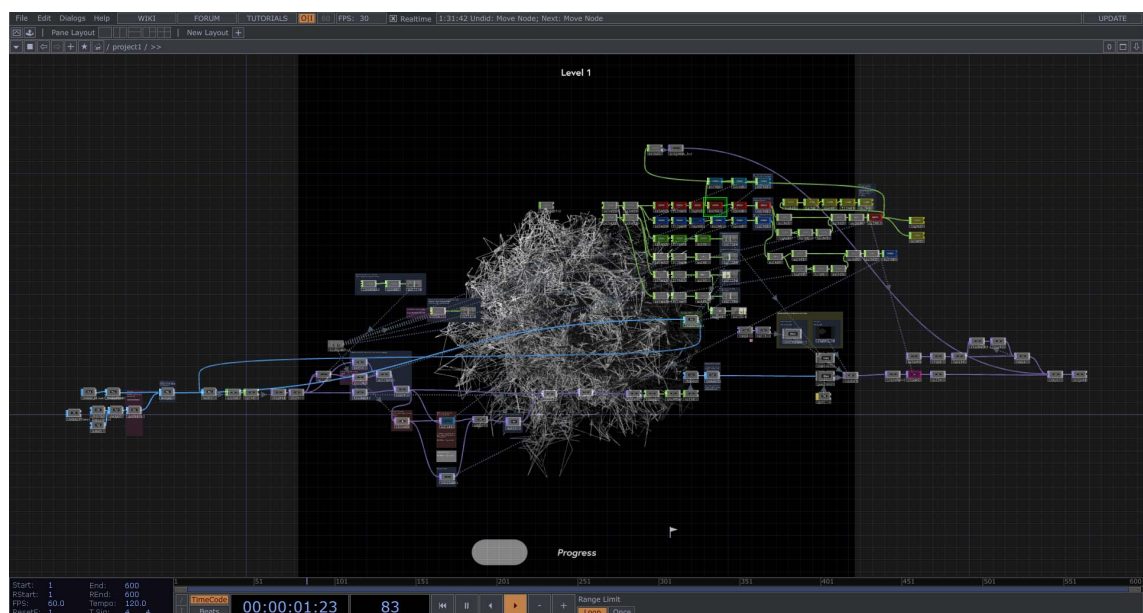


Figure E.4 *Moment* TouchDesigner System (Lotus)

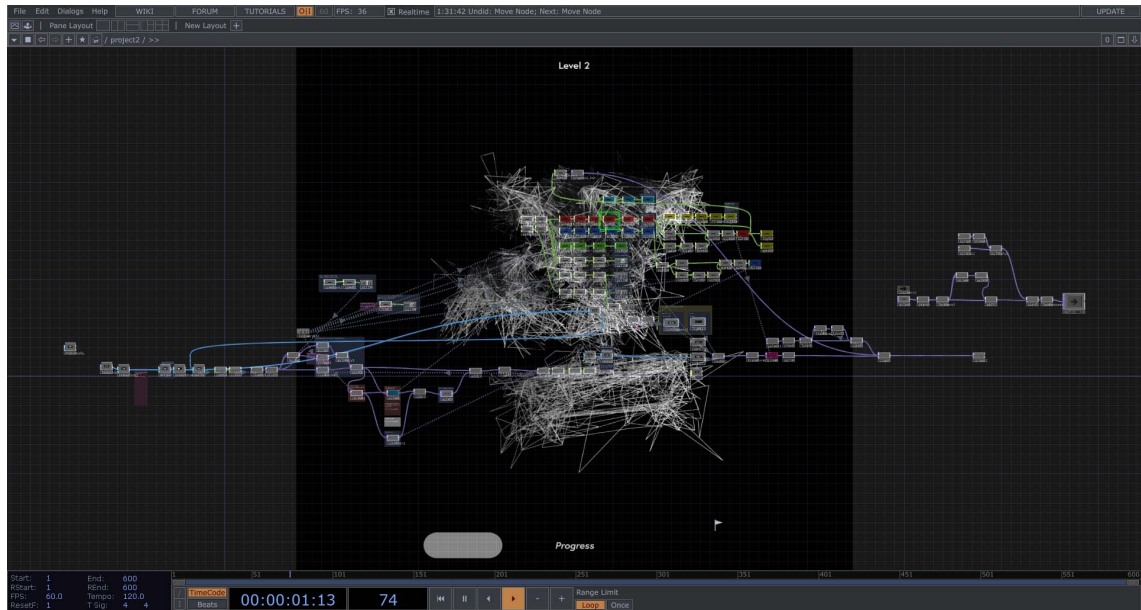


Figure E.5 *Moment* TouchDesigner System (Bonsai)

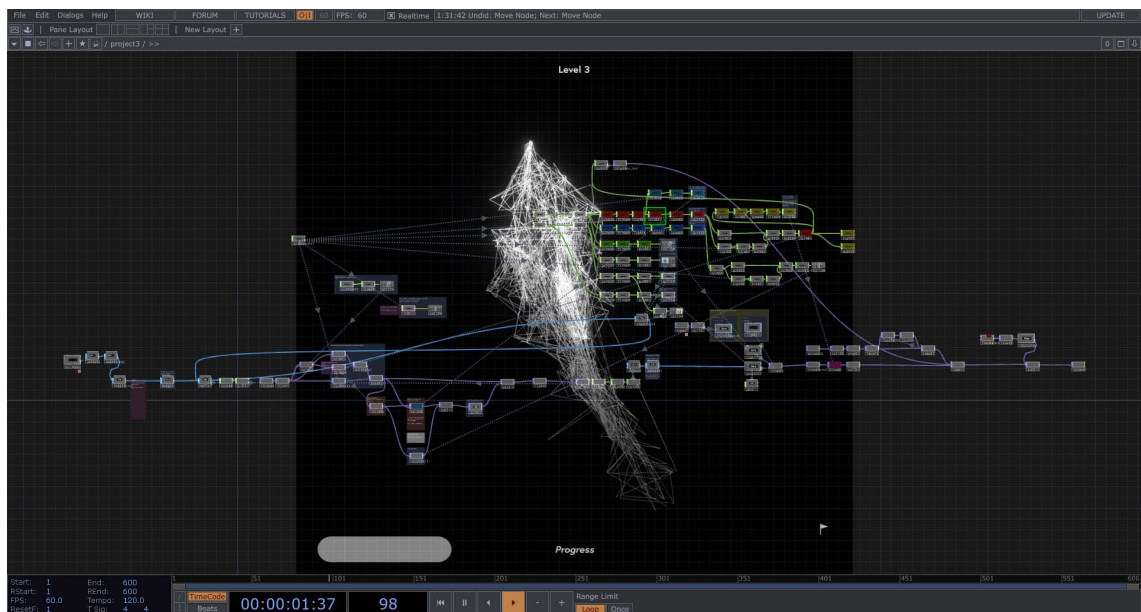
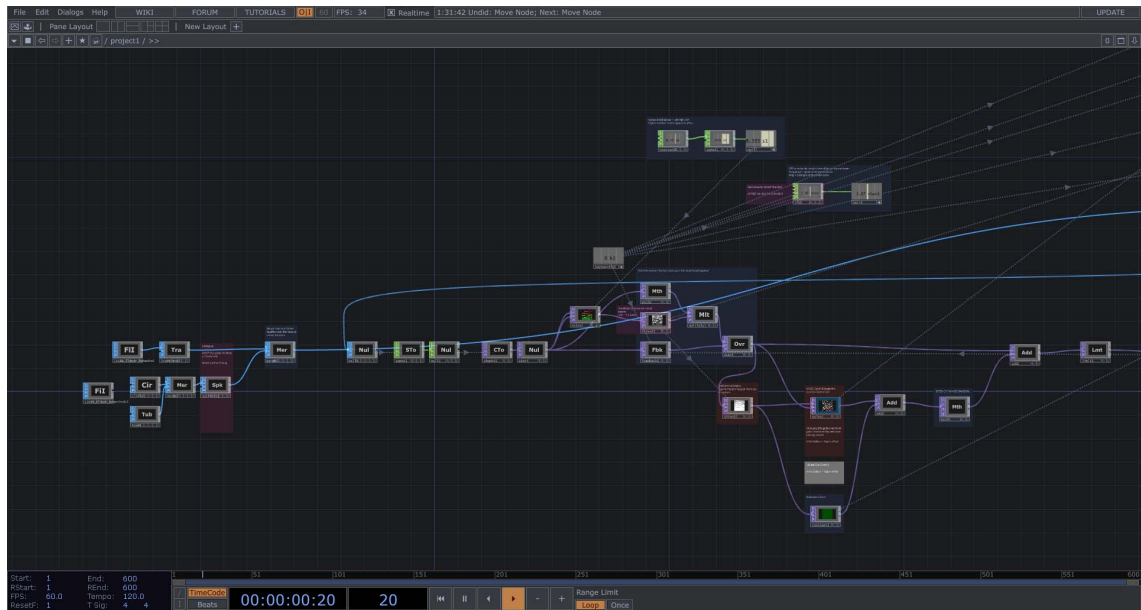
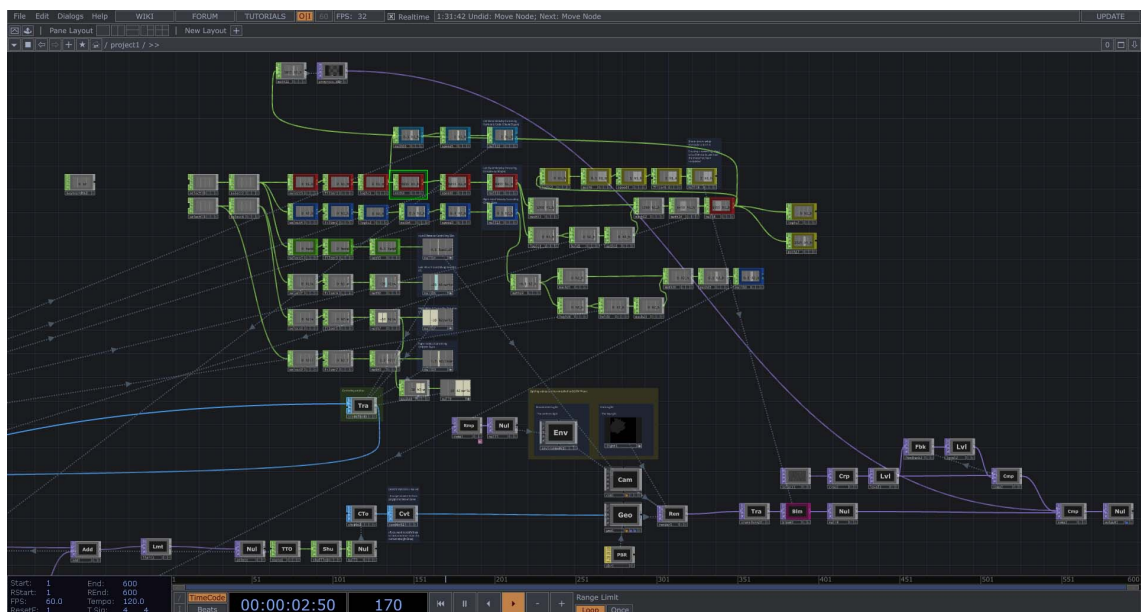


Figure E.6 *Moment* TouchDesigner System (Koi)

Figure E.7 *Moment* TouchDesigner System - Inner Close UpFigure E.8 *Moment* TouchDesigner System - Inner Close Up 2