MindfulBloom: Spatial Finger Painting for Mindfulness Intervention in Augmented Reality

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Figure 1: With the rising popularity of extended reality devices in workspace, we envision MindfulBloom's AR-driven finger painting to offer a creative way of in-the-moment mindfulness intervention.

ABSTRACT

Mindfulness interventions emphasize the importance of being present in the moment. While many digital mindfulness tools are limited to flat screens, extended reality (XR) offers more immersive solutions. However, existing XR mindfulness practices often lack the connections to user's real-world present moment, essential for mindfulness. We introduces MindfulBloom, a novel approach merging augmented reality (AR) and finger painting interaction for digitally supported mindfulness. Building on studies that highlight finger painting's therapeutic potential, our system guides users through an intuitive finger painting interaction in their workspace, translating stress clutters into spatial, artistic expressions. We explores its potential to direct body attention to the present moment, offering a creative solution to the in-the-moment mindfulness interventions.

CCS CONCEPTS

• **Human-centered computing → Mixed / augmented reality**; **User centered design**.

KEYWORDS

Augmented Reality, Human-Centered Design, Mindfulness, Well-being

1 INTRODUCTION AND RELATED WORK

Mindfulness interventions are recognized as effective tools for stress reduction and enhancing psychophysical well-being [7]. Mindfulness, as defined by [14], is a process that *brings a quality of attention to the present moment*, in a non-elaborative, non-judgmental manner, often described as a feeling of being fully present and alive in the moment [4]. Aligning with mindfulness principles, finger painting, traditionally speaking a creative practice, has been found for its mindfulness benefits in psychotherapy [1], education [5], and rehabilitation [16]. The body movements and tactile activities during finger painting have been studied to enhance state mindfulness and attention [22]. The deliberate strokes encourage reflection and engagement over time [11], fostering mindfulness and present moment awareness [6].

With digital mindfulness apps gaining popularity [6–8], most of them are restricted to a flat 2D screen. The lack of intuitive and engaging guidance increases difficulty for beginners to start

1. In-the-moment Intervention

1. Our user, the future worker, wears an AR headset with stress level tracker. When they are stressed, virtual objects symbolizing stress subtly appear around the environment to notify them.

2. Symbolic Finger Painting

2. They finger-paints towards stress symbols in mid-air and on their desk, transforming them into calming visuals, directing their body attention to the surrounding environment.

Figure 2: MindfulBloom Storyboard - We choose the user scenario in a workspace environment. 1. In-the-moment notification of start. 2. Finger Painting Exercise

and maintain [3, 9]. Extended reality (XR) technologies offer new avenues with its rising usage in everyday settings. [9, 26]. Their usage of immersive visual elements and active body movements are found to guide user's body attention in a more subtle way with less distractors [18, 20, 23]. Example techniques include: embodiment of virtual avatars and body ownership [10, 24], engagement in multi-sensory scenes [21, 25], visualization of biofeedback [15, 17], and sharing of virtual environments [13].

Most existing XR-based mindfulness practices are fully virtual, immersive but detaching from the real-world, without interactions with user's physical space. However, forming connections to the present moment are essential qualities to mindfulness [9, 12]. Towards in-the-moment digital mindfulness interventions, Augmented Reality (AR), blending digital elements with real-world contexts [2, 27] holds promise. In the context of finger painting, the advent of hand tracking in consumer devices also opens new potential for digital finger painting on any physical surface.
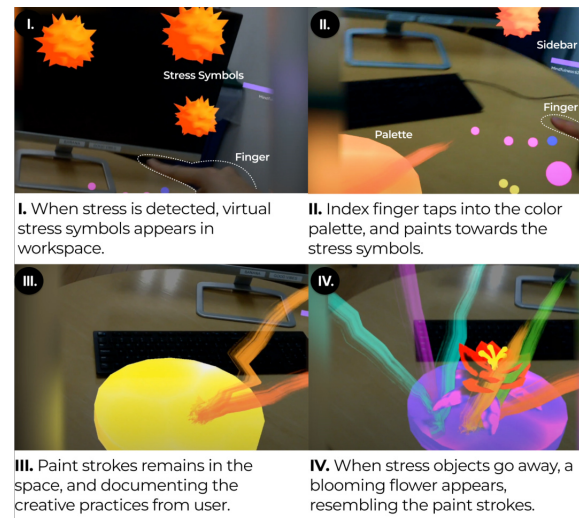
Despite these emerging opportunities, research on XR finger painting for mindfulness remains sparse. Bridging the gap, our work advances the digital mindfulness tools by leveraging augmented reality to bring body attention to the present moment via an intuitive finger painting interaction in user's workspace. By introducing MindfulBloom, we aim to seamlessly offer in-the-moment interventions, and transform mindfulness practices into creative expressions through fingertips.

2 DESIGN DESCRIPTION

2.1 Mindfulness Exercise Interaction

With the storyboard of MindfulBloom presented in Fig.2, we describe its user interaction as a digital mindfulness tool here. User wears a AR headset with stress level tracker during work. When stress level arises, orange "stress objects" slowly appear in their desk area surroundings to notify the user (Fig.3.I). As user places their palm on the desk, an ink pool appears at the center of their hand, which will be the starting point of the spatial finger painting. By forming their hand into a pointer pose with their index finger straight out, they can start the activity by dipping their finger in the ink pool and moving their hand around in their desk area.

Guided by stress symbols, users paint freely in their workspace, with a floating sidebar tracking mindfulness state (Fig.3.II) When the user "hits" a stress symbol with index finger, the stress symbol is removed, visually signifying the "de-stressing" process. The user can self-define their paint strokes pathway, offering a freedom to creativity (Fig.3.III). When all the stress objects have been painted away, a Zen flower appears in the middle of the pool, signifying the exercise is complete and represents a visual encouragement to continue this mindfulness practice (Fig.3.IV). Through painting stress objects away, our system guides user's body attention through movements around their workspace, unleashing creativity and fostering mindfulness. [1]

I. When stress is detected, virtual stress symbols appears in workspace.

II. Index finger taps into the color palette, and paints towards the stress symbols.

III. Paint strokes remains in the space, and documenting the creative practices from user.

IV. When stress objects go away, a blooming flower appears, resembling the paint strokes.

Figure 3: Visual Elements: I. MindfulBloom Stress Symbols around desk area; II. Index Finger Dipping and Painting; III. Paint Stroke Creations from Palette; IV. Zen Flower as an ending indicator

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[1]Please see our complete demonstration video
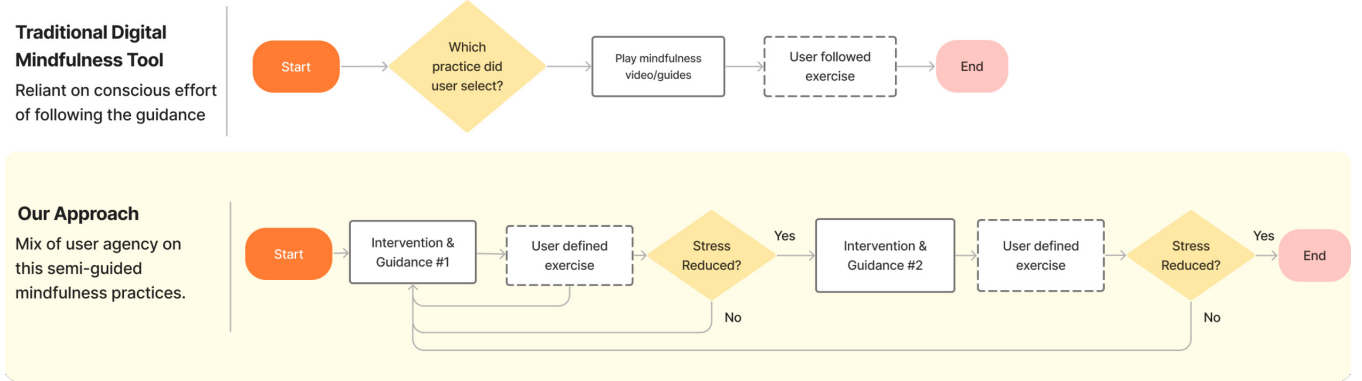
Figure 4: User Flow - Users are subtly notified and semi-guided by 'stress symbols', but maintains autonomy during finger painting creations.

2.2 User Flow

With the aim of guiding user's body attention, in our user flow, we introduce an approach that seamlessly integrates user autonomy with structured mindfulness guidance (Fig.4). Traditional mindfulness tool (Screen-based and XR) often presents a finite set of instructions that ask users to follow along, such as [10, 15, 24], often requiring a conscious effort to follow along, hard for beginners to start and maintain [3, 22].

In MindfulBloom user flow, users have the autonomy to paint strokes in their own creative way during the mindfulness exercise, while we maintain notifications and instructions during its initiation and conclusion through subtle guidance, such as stress symbols and ending flower. The user flow is presented in repeated loop, where the user's mindfulness state are tracked and impacted the starting and ending of the practice. If the user hasn't achieved adequate mindfulness, stress symbols reappear, signaling another cycle. Drawing from traditional finger painting's impact on emotions and cognition, our approach encourages users to a self-defined body movements, directing their body attention to their present environment.

3 IMPLEMENTATION
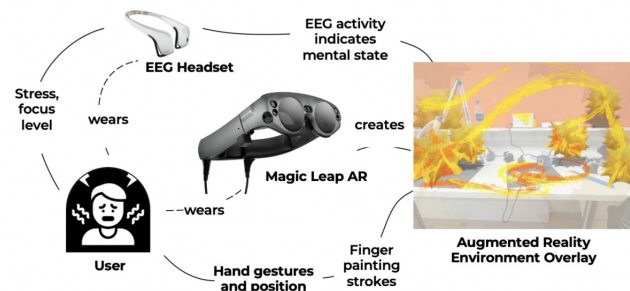
Figure 5: System Implementation

We implemented our system through an AR finger painting scene that integrates an EEG stress/mindfulness level sensor (Fig.5). We

employed the Magic Leap 1 device for AR rendering and hand tracking, and developed the system using Unity with Lumin SDK 26.0 and Zero Iteration. We collected index finger positions from the finger painting gesture, mapping it to the finger paint line position. Before start, a calibration process is incorporated to adjust scene height by logging the user's palm position. To track the user's stress/mindfulness level using EEG, we utilized MUSE 2.0, a consumer-grade EEG headset designed for monitoring real-time mindfulness states. The data is pre-processed and classified using BrainFlow [19], a widely-used open source BCI Python module. The EEG-derived mindfulness percentage is visualized into the floating sidebar. While the stress tracker is external due to current device constraints, our setup showcases its potential for future integrated solutions.

4 PILOT WORKSHOP

We facilitated a live demo workshop in the university, in which about ten Design, HCI, and adjacent faculty / students participated and gave feedback for the concept and current prototype (Fig.6).

4.1 Procedure

The demo was held in a controlled environment, with the participant sitting down in front of an office desk in a semi-lit environment, with office technology such as a monitor, keyboard, and PC surrounding them for context for our concept interaction. We used the same prototype from the last section for the workshop. After ensuring participants are properly wearing the headsets, they're guided to initiate the scene by placing their dominant hand facedown on a table. They went through the user flow with 1 cycle of finger painting exercise.

4.2 Reflection and Future Improvements

Enlightened from the feedback received from pilot workshop, we plan the future iterations of this current work. We will carry these improvements to our future user experiment to quantify the effectiveness of our system.

4.2.1 Finger Painting Interaction. - Participants appreciated the novel experience of spatial finger painting. All of them were able

Figure 6: Photos taken during demo workshop with participants giving feedback to our prototype.

to created their own paint strokes in the space, in which most described it as a more engaging and immersive experience compared to existing mindfulness apps. However, clarity regarding the initiation of painting were some recurrent critiques. While we hoped to present a subtle notification to trigger the finger painting phase, a subset of participants sought further instructions on executing paint strokes.

Guiding mindfulness practices to ensure they're intuitive and require minimal cognitive effort remains a priority. To subtly, and more organically guide users' finger towards the stress symbols, we plan to incorporate distance indicators such as 'hovering' effects and distance lines. For example, stress symbols appear semi-transparent initially; when user's finger approaches, some gradually start glowing, with a connecting lines appearing between finger tip and the stress symbols.

4.2.2 Stress Symbol Placement. - While the gradually appearing stress symbols were able to notify our user about their mental states, concerns were around stress symbol clusters which were barely fitted into and associated with the office environments at their first glance. To improve our in-the-moment intervention, we plan to reposition stress symbols to the side of stress-causing physical items, to emphasize connections between paint stroke visuals to the real-world stressors. To direct attention to specific physical space, we will prompt users to link stress symbols with their immediate stress origins in their surroundings, and 'paint' them away.

5 CONCLUSION

We present MindfulBloom, an AR-based spatial finger painting for mindfulness. While digital tools miss real-world connections, our method combines AR's contextuality with finger painting's therapeutic effects. By transforming stressors into spatial art, we offer an engaging and creative in-the-moment intervention. Our semi-guided practice encourages users to direct body attention around their workspace, and enhance mindfulness to the present moment. With the growing use of extended reality in workplaces, we believe MindfulBloom contributes to an innovative approach for in-the-moment mindfulness interventions.

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