

GANLAI: A Multimodal AI-Driven Virtual Reality Boxing Game Prototype for Stress Relief

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Abstract— Generation Z faces disproportionately high levels of anxiety and depression, creating a need for accessible stress-relief approaches that extend beyond short-term distraction. Current virtual reality (VR) exergames offer immersive and engaging exercise experiences, but they often reduce performance feedback to raw numbers or charts, lacking opportunities for self-reflection and long-term motivation. Moreover, many games risk functioning merely as temporary escapes, leaving players with feelings of emptiness once gameplay ends. To address these challenges, we present “苦 Gym 甘來” (GANLAI) prototype, a multimodal AI-driven VR boxing exergame that transforms exercise data into personalized narrative feedback, enabling deeper reflection and sustained engagement. By combining immersive combat with language-based coaching, GANLAI externalizes users’ stressors, contextualizes physical performance within their emotional states, and generates reflective insights that sustain engagement beyond gameplay. Through a multimodal AI feedback system that interprets emotional cues and exercise data, supporting both psychological well-being and fitness management. Our work explores how the combination of VR and multimodal AI might be leveraged not only to support real-world stress relief through immersive virtual experiences but also to cultivate self-awareness, resilience, and motivation that extend into everyday life.

I. INTRODUCTION

Members of Generation Z (ages 18–27) face disproportionately high levels of anxiety and depression, with lower emotional regulation and positive engagement compared to previous generations [1]. As daily stress from academic, professional, and social pressures accumulates without timely release, many young adults turn to digital games for relief. Prior research [2] shows that gameplay can reduce anxiety, support emotional regulation, and induce flow states that improve well-being, making it a widely adopted coping strategy. However, such relief is often temporary: players frequently report feelings of emptiness or renewed anxiety after gameplay, revealing a gap between virtual experiences and lasting psychological benefits. Virtual reality (VR) exergames [3] offer immersive and engaging exercise experiences with the potential to address this issue, yet current systems remain limited. They often present performance feedback as raw numbers or static charts that are difficult to interpret, and text-based feed-

back, when present, lacks nuance and personalization. As a result, users miss opportunities for meaningful self-reflection and intrinsic motivation, and most systems fail to extend psychological support beyond the duration of play.

To address these challenges, we conducted a user study to understand players’ needs and expectations in VR exergames, informing our design of “苦 Gym 甘來” (GANLAI) prototype, a VR boxing exergame that transforms exercise data into personalized narrative feedback. GANLAI visualizes stressors as tangible in-game opponents users can confront and defeat, helping them process emotional burdens rather than merely serving as an escape. After gameplay, the system delivers personalized *encouragement cards* that reflect users’ emotional states and provide actionable suggestions, bridging the gap between virtual experiences and real-world behavior change. GANLAI supports a psychological transition from temporary avoidance to re-engagement with real-world challenges, cultivating the confidence and readiness to return to reality rather than merely offering escape. By combining immersive combat with language-based coaching and a multimodal AI feedback system that interprets emotional cues, GANLAI externalizes users’ stressors, interprets their performance, and generates reflective insights that support both psychological well-being and fitness management. Guided by these goals, we explore the following research questions (RQ):

- **RQ1:** How can a VR exergame be designed to provide immersive interactions that support stress relief?
- **RQ2:** How can AI turn exercise data into personalized narratives to deepen reflection and sustain motivation?
- **RQ3:** How can gameplay mechanisms extend psychological benefits beyond the virtual world to reduce post-game emptiness and foster self-motivation?

II. USER STUDY AND PERSONA DEVELOPMENT

To inform our design, we conducted a user study with 48 survey responses and 7 in-depth interviews of participants aged 20–27. The findings revealed three key needs for next-generation VR exergames: (1) emotionally supportive and non-intrusive feedback during play that avoids overwhelming text, (2) intuitive and encouraging reflections after gameplay

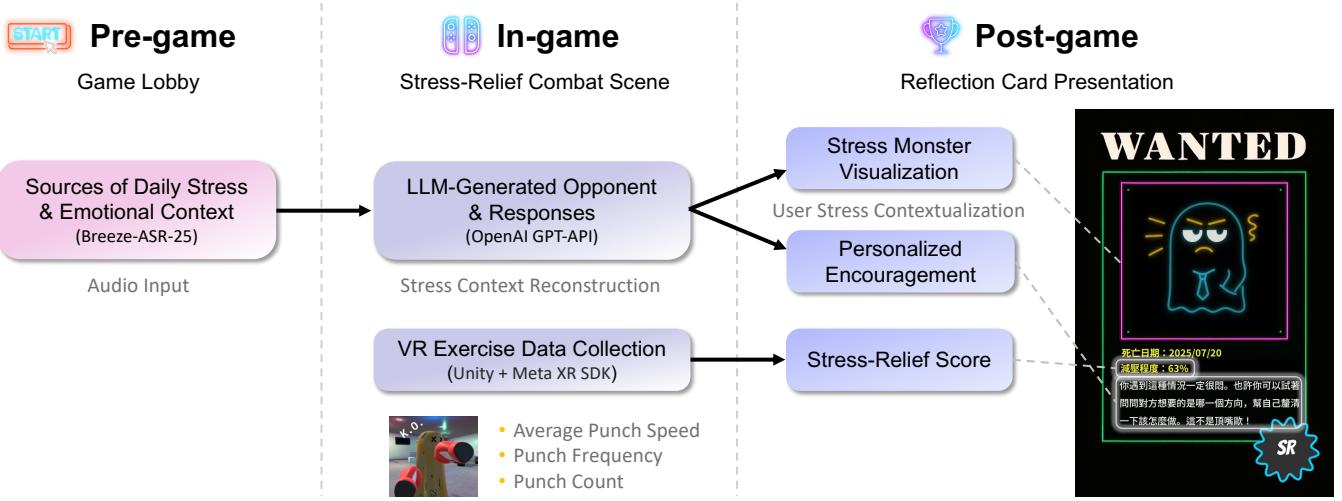


Fig. 1 System Design of GANLAI Prototype. The system consists of three main stages: Pre-game, where users describe their sources of stress and emotional context through audio input; In-game, where an AI-powered module reconstructs the user’s stress context to generate personalized opponents and responses while collecting VR exercise data such as punch speed, frequency, and count; and Post-game, where the system transforms these inputs into contextualized feedback, including a stress-relief score, visual representations of the “stress monster”, and personalized encouragement messages. These components are compiled into a reflection card that helps users visualize their emotional journey and track changes in stress over time.

instead of raw numerical data, and (3) long-term engagement features such as progressive goals, rewards, and milestone tracking. Based on these insights, we developed a representative persona, Jacky, a 25-year-old office worker and experienced gamer who seeks immersive and cathartic gameplay to relieve stress. Jacky hopes to confront tangible representations of stress, receive personalized narrative feedback, and stay motivated through clear progression and rewards. However, current VR exergames frustrate him with cold metrics, weak motivation, and little real-world relevance. These findings shape our design challenge: *How might we design a VR exergame that not only offers immediate stress relief but also transforms exercise data into motivating narratives, sustaining engagement and extending psychological benefits beyond the virtual environment?*

III. GANLAI PROTOTYPE

Our design, “苦 Gym 甘來” (GANLAI), is a multimodal AI-driven VR boxing exergame that transforms physical activity into an emotionally meaningful and motivating process. The system forms a closed-loop experience from stress awareness to post-game reflection through three core modules.

Emotional Elicitation. The experience begins with a brief pre-session interaction in which users verbally describe their current stressors, mood, and emotional states in natural language. Using Whisper for robust speech-to-text conversion and emotion recognition, the system extracts affective signals and contextual cues from the user’s input. This personalized emotional context informs subsequent gameplay and post-game reflection, ensuring that the VR session is not just a generic workout but one grounded in the user’s lived experience and psychological state.

Stress Quantification. During the VR boxing session, GANLAI captures motion data such as **punch speed**, **frequency**, and **total count** through real-time tracking. These features are aggregated into a *stress-relief score* via a predefined formula. This score is reframed as an indicator of emotional release, quantifying how effectively users channel and process their

stress through embodied interaction. This shift from “*performance data*” to “*affective data*” directly addresses a key limitation of existing exergames and builds a bridge between physical action and emotional meaning.

Narrative Reflection. After gameplay, GANLAI integrates physical data with the emotional context collected before the session to generate personalized reflections. A vision generative model produces a symbolic image of the user’s stressor, translating abstract emotions into a tangible form the user has defeated. Simultaneously, an LLM [4] generates personalized, encouraging messages contextualized to the user’s state and gameplay performance. These outputs, together with the stress-relief score, are compiled into a *reflection card*. Over time, these cards create an evolving emotional journal that not only visualizes stress patterns but also reinforces agency, progress, and resilience beyond the VR environment.

IV. CONCLUSION AND FUTURE WORK

We present “苦 Gym 甘來” (GANLAI) prototype, a multimodal AI-driven VR exergame that transforms exercise data into personalized narrative feedback and visualizes stress as tangible opponents users can confront. By reframing VR from a temporary escape into an emotionally meaningful outlet, GANLAI helps users externalize and process everyday stress while cultivating the confidence to re-engage with real-world challenges. For future work, we plan to conduct controlled user studies to evaluate the system’s impact on emotional well-being, intrinsic motivation, and sense of agency. We will also examine whether narrative feedback mitigates post-game emptiness and supports sustained engagement.

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