Bio-Mechanical Poet: An Immersive Audiovisual Playground for Brain Signals and Generative AI

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Abstract

This paper introduces the "Bio-Mechanical Poet", an adaptive brain-computer interface that integrates realtime electroencephalography (EEG) data with advanced generative artificial intelligence to create immersive audiovisual poetic experiences. We describe a custom prototyping environment for the exploration of various biosignals and their integration in a multimodal pipeline. By mapping brain states to symbolic representations, we explore trajectories of neural states in a multimodal symbolic latent space. This enables humaninterpretable access to it via the modalities of generative music, diffusion-based visuals and AI-crafted poetry. In doing so, we illustrate how the symbiosis of biosignals and generative systems can provide rich multimodal artworks guiding the user throughout the experience. Our discussion centers on the influence of biofeedback systems integrated with generative AI on evolving storytelling methods and altering perceptual states. We further discuss how translating biosignals into tangible expressions could open new avenues for understanding and interacting with our physiological and subconscious selves. Bio-Mechanical Poet exemplifies the potential of biofeedback and real-time feedback systems to foster advancements in the field of computational creativity. offering insights into the integration of human brain dynamics with artistic creation.

Introduction

The recent advent of generative artificial intelligence (AI) systems has significantly broadened the horizon of human creativity, while challenging our conceptions of the dynamical processes underlying it. This expansion raises intriguing questions about the synergy between human and artificial systems (Fui-Hoon Nah et al. 2023; Hughes, Zhu, and Bednarz 2021). While instrumental use-cases of such AI systems are widespread, new modes of interaction become possible and invite us to rethink our ways of generating meaningful and aesthetic artifacts. Simultaneously, advances in neurofeedback technologies relying on electroencephalography (EEG) have opened novel pathways for incorporating biosignals into the creative process, leading to what we call bio-adaptive art. The convergence of these two domains heralds a new era of exploration in creativity, where the integration of EEG data with generative AI fosters innovative

modalities of artistic expression. This paper introduces the "Bio-Mechanical Poet", an adaptive brain-computer interface that epitomizes this convergence. By harnessing realtime EEG data and channeling it through advanced generative AI, we unlock the potential to create immersive audiovisual poetic experiences that allow to dynamically interact with multi-modal latent representations.

The motivation behind crafting such immersive experiences is anchored in the ambition to dynamically navigate the latent spaces offered by multiple generative AI systems simultaneously. By doing so, a multi-modal exploration of neural states and their symbolic representations can be facilitated, thereby enriching the narrative and emotional depth of the generated artworks. At the core of our exploration is the thesis that the intersection of biofeedback, generative AI, and storytelling heralds a new frontier in adaptive art forms. While the use of EEG in art and the application of generative AI for creative purposes are not entirely new, their synergistic integration within the Bio-Mechanical Poet represents a step toward dynamical co-creative systems. This approach sets up for a direct interface between the artist's neural activity and the creative output, blurring the lines between the creator and the creation. Through this exploration, we aim to provide deeper insights into the potential of biofeedback and real-time feedback systems in enriching and diversifying the landscape of artistic creation.

Background

We will first provide a brief overview of recent works on the creative uses of Generative AI, artistic biofeedback systems and adaptive storytelling techniques. In doing so, we will situate the Bio-Mechanical Poet in the landscape of bioadaptive art, while highlighting the gap it intends to bridge.

The Creativity of Generative AI

The accelerating pace of generative AI development is arguably challenging our conception of creativity and our understanding of the specificity of human creativity. Although it has also been met with share amount of skepticism, generative AI is undoubtedly transforming a wide range of artistic professions and opening new avenues of creative expression. Even if Large Language Models (LLMs) allow for the creation of poetry and imaginative stories, while diffusion-based models allow for the generation of impressively aesthetic images, it remains questionable to qualify their inner process as creative per se. Creativity has long been proposed to rely on an interplay between variation and selection processes (Simonton 2011). This dynamic can analogously be understood through the lens of reinforcement learning, which separates its mechanisms into exploration (variation) and exploitation (selection), with the creative outputs primarily arising from the exploration activities. In this context, generative AI systems allow for the easy exploration of a large number of variations, while the selection process remains tightly bound to human decisionmaking. Moreover, the necessity for prompt engineering and trial-and-error iterations also exemplifies how human decisions are paramount in the creative applications of generative AI systems. Although generative AI tools may not be creative in themselves, their integration within artistic practices can provide new grounds for human creative expression through synergistic co-creations in which components of the creative process are distributed across biological and artificial systems. Nonetheless, the potential of generative AI to mirror, and even stimulate human creativity opens up unprecedented possibilities for human-machine collaborations in creative endeavors (Adesso 2023; Chung 2021; Kreminski and Martens 2022; Osone, Lu, and Ochiai 2021; Shakeri, Neustaedter, and DiPaola 2021).

Artistic Biofeedback

Brain-computer interfaces (BCIs) are hardware and software communication systems that permit cerebral activity to interact with computers or external devices. BCIs can be clustered into three main types based on the nature of the interaction between the subject and the apparatus: active, reactive and passive BCIs (Zander et al. 2014). The first two types, active and reactive BCIs, fall under the general idea of explicit control. First, active BCI implies an attempt at deliberate control over features of brain signals that are independent from the stimuli, while reactive BCI relies on the use of external influence to elicit that control. Classical examples of active BCI are the use of sensorimotor rhythms elicited by motor planning to interact with a computer system (Kübler et al. 2005). Examples of reactive BCI include the use of event-related potentials (ERP) and steady-state evoked potentials (SS-EP), which correspond to brain signal features that are triggered by external stimuli and that can inform the system about a subjects attentional focus (Zhu et al. 2010).

The third type of BCI relies on implicit control and is therefore called passive BCI. Passive BCI (Poel et al. 2012; Zander et al. 2014) "strive to portray dimensions about the user that are otherwise invisible to a computer, and use brain data to update system parameters whose values are better left beyond direct user control or attention but might still be usefully adjusted in response to the user's cognitive profile" (Hincks et al. 2017).

Neurofeedback systems, a specific type of BCI, analyses brain signals in real-time, typically acquired through electroencephalography (EEG), to provide a feedback to the user as a way to inform them about their internal state, either using visual and auditory stimuli. While its primary use mostly targets clinical applications in a plethora of psychiatric conditions (Marzbani, Marateb, and Mansourian 2016), artistic applications of such systems have been increasingly explored over the past decades. In their systematic review on BCI in contemporary art, Prpa and Pasquier (2019) refer to "semi-active" BCI when the participants' agency falls between boredom (predictability) and chaos (unpredictability). They propose the concept of controlled unpredictability, suggesting that manipulating the complexity of the feedback might enable new types of BCI to emerge, akin to the idea of bidirectional entropic BCI brought by Hincks et al. (2017). Andujar et al. (2015) define artistic BCI as an instance of affective BCI, a system that aims at understanding the user's affective state through artistic forms. A recent review, focused on the potential applications of BCI to the field of creativity, identified six papers that provided interactive creative expression systems (Vanutelli, Salvadore, and Lucchiari 2023). From these applications, three used EEG to control generative visuals, either in the form of mandala (Tokunaga and Lyons 2013), self-portrait (Kim and Kim 2015) or spirals of spheres (Folgieri et al. 2017). Another work focused on building immersive spaces with amorphous nature-inspired phenomena relying on generative Voronoi structures (Song et al. 2019). Finally, some systems made use of AI algorithms, either using Generative Adversarial Network (GAN) for painting creation (Riccio et al. 2022), or real-time classification for music generation (Harel et al. 2019; Xu and Wang 2021).

Adaptive Storytelling

Adaptive storytelling is a narrative approach where the story dynamically evolves in response to user interactions, preferences, and feedback. Emerging technologies in gaming and entertainment, which combine advanced visualization, speech processing, and autonomous agents, have been used to craft interactive storytelling systems providing personalized entertainment experiences tailored to individual users (Klimmt et al. 2012; Roy et al. 2024). A recent AIdriven strategy has been developed in which narratives dynamically evolve based on user feedback, such as comments or questions, aiming to captivate audiences by mirroring the adaptive nature of oral storytelling (Garber-Barron and Si 2021; Ortiz et al. 2011). Their research underscores the importance of balancing novelty with consistency, suggesting that while introducing new content is vital for engagement, revisiting familiar themes can deepen the narrative's impact. Adaptive storytelling has also been implemented in systems capable of generating multiple storylines and proposed as a means to integrate diverse multimedia formats within a unified narrative framework (Kim et al. 2011). A few projects have incorporated physiological signals in the construction of interactive stories or games, either to adapt game difficulty (Chanel et al. 2011), horror level (Lobel et al. 2016), or manipulate engagement (Frey et al. 2020). The context in which the system evolves based on users' physiological responses without requiring active input is also referred to as passive interaction, and is thought to enrich the narrative experience by aligning it more closely with the user's emotional state (Gilroy et al. 2012). Together, these studies embody the shift towards personalized storytelling experiences, facilitated by interactive and AI systems.

Integrating Biofeedback with Generative AI

With the increasing accessibility and computational affordability of generative AI algorithms, new generations of artistic biofeedback systems gain the possibility of integrating state-of-the-art generative AI techniques into real-time feedback loops. The Deep Dream algorithm, based on Deep Convolutional Neural Networks, was recently used in a proof-of-concept system intended to simulate lucid dream states by combining virtual reality with physiological data input (Kitson, DiPaola, and Riecke 2019). Another study explored the co-creative journey of artists with generative AI using diffusion models to examine the transformative interplay between human intention and algorithmic influence in art-making (DiPaola and Choi 2023). The present work builds on this new usage of multimodal latent spaces to provide a playground for intuitive and creative endeavors explored through biosignal-driven modulations. This system bridges the gap between biofeedback technologies and artistic expression, harnessing the capabilities of generative AI to translate neural signals into tangible multimodal artistic outputs.

System Design and Implementation

The Bio-Mechanical Poet is designed as an audiovisual and poetic feedback loop relating subjective experience to abstract archetypes. The system invites each user to live through a novel generative experience that serves both as a projection surface that steers the user into a mystical poetic story unique to their current brain dynamics. We deliberately designed the experience in a way that puts the user's mind at the center of creation to encourage personal reflection around the generated symbols.

In this section, we describe the implementation of the Bio-Mechanical Poet by dividing the system into four main components (Figure 1): Feature Extraction, Matching Algorithm, Symbolic Assemblage and Music Generation. We explain each component and how they are integrated to the full real-time pipeline.

Feature Extraction

The feature extraction step is the start of our pipeline and is concerned with the analysis of raw brain signals measured using electroencephalography (EEG). EEG measures the electric field emitted by action potentials in cortical neurons and captures local changes in brain activity in an area under each EEG sensor sitting on the scalp or forehead. Brain activity captured by EEG consists of oscillatory electrical potentials roughly in the frequency range from 0 to 100 Hz. Similar to sound waves, brain waves carry information through varying phases and amplitudes in specific frequencies, and can be quantified by transforming the signal into the frequency domain. This type of analysis, commonly referred to as spectral analysis, is the central tool for feature extraction in this work. Specifically, we compute the power spectrum (amplitude across frequency spectrum) over a short buffer (4 seconds) of raw EEG and extract the peak frequencies, i.e. dominant oscillatory modes of the signal.

More specifically, spectral peaks are computed by first applying Empirical Mode Decomposition (EMD) (Rilling, Flandrin, and Goncalves 2003) to the raw signal. This datadriven method decomposes a signal into a set of Intrinsic Mode Functions (IMF), each of which corresponds to iteratively lower frequency regions of the spectrum. A Welch transform is then applied to each IMF and the frequency bin with the maximal energy is identified as a spectral peak. These peak frequencies, as well as the ratios between peak frequencies representing musical intervals and rhythms, are passed along to other components in our pipeline (Music Generation and Matching Algorithm) and act as the seed for symbolic abstraction.

In addition to the peak frequencies we also extract the average power in six canonical frequency bands (delta [1-4Hz], theta [4-8Hz], alpha [8-12Hz], low-beta [12-20Hz], high-beta [20-30Hz], gamma [30-45Hz]) as well as the Lempel-Ziv complexity (Ziv and Lempel 1978) of the raw EEG to assess the user's brain state according to common metrics used in neuroscience research. This secondary set of features is used to orientate the perspective onto the generated symbols by means of stylizing the audiovisual experience. This will be explained in more depth in Section Symbolic Assemblage.

Our system is agnostic towards the type of EEG equipment used to record the data, leading to high flexibility in terms of accessibility, ease of use, and signal quality. In the context of a public exhibition, for example, we might choose a light system that is ready to use in a matter of seconds (e.g. the InteraXon Muse headband with 4 EEG sensors), while more in-depth sessions with the Bio-Mechanical Poet may benefit from research-grade signal quality across a larger number of sensors and more thorough calibration to achieve the highest performance.

The feature extraction is implemented in the *goofi-pipe* software (Figure 2, top), which is a tool for real-time creative exploration of neuro-/biosignals (github.com/PhilippThoelke/goofi-pipe) that makes use of the *biotuner* package (Bellemare et al. 2024) for the identification of spectral peaks.

Matching Algorithm

This component is centered around the generation of abstract symbolic concepts from numerical brain features computed in the previous step. We utilize the spectral peaks from the user's EEG to determine a set of abstract symbols from which a narrative is formed. We employ a matching algorithm between EEG features and three domains of symbolism, taking advantage of spectral representations for each of these domains. While the frequency range and source of oscillatory activity are widely different between the spectra of EEG and the symbolic domains, they fundamentally represent ensembles of vibrations having a common structure. We used emission spectra of chemical elements, atmospheric spectra, and color frequencies in our matching algorithm to correlate EEG signals with corresponding natural phenomena, enabling the derivation of diverse visual and



Figure 1: **System design of the Bio-Mechanical Poet.** As a first step, features are extracted from brain signals. Spectral peaks are the main feature used to feed subsequent steps in the pipeline. The music generation step involves computing the arithmetic ratios of spectral peaks and then deriving associated spectral chords and Euclidean rhythms. The matching algorithm compares brain spectral peaks with the emission spectra of periodic table elements, solar system planetary atmospheres spectra, and the human visible color spectrum. The symbolic assemblage involves interpreting the detected components symbolically using two instances of OpenAI GPT, the first one providing a text-to-image prompt and the second generating poetry. Finally, the output image is generated by feeding the text-to-image prompt to a Diffusion Model.

poetic elements. This approach unlocks significant artistic potential by drawing on the unique characteristics of each matched element.

Emission Spectra Each chemical element has a unique electromagnetic emission spectrum that is characterized by the set of transitions from high-energy to low-energy states that electrons can make within an atom. Here we limit the selection to 66 most well-known chemical elements. This strategy ensures that the ensuing symbolic interpretation will be endowed with greater significance, as a richer array of linguistic symbolic content will be affiliated with these elements within Large Language Models (LLMs).

Atmosphere Spectra A planet's atmosphere comprises many elements, which can be inferred from analyzing its transmittance spectrum, which represents the transmittance of light or other electromagnetic radiation through a material as a function of wavelength or frequency. Here we computed the main spectral peaks of the atmospheric planets of the solar system, specifically Venus, Earth, Mars, Jupiter, and Saturn. Transmittance spectra were generated using the Planetary Spectrum Generator developed by NASA (Villanueva et al. 2018)

Color Frequencies The visible light spectrum extends from approximately 400 THz (red) to 790 THz (violet), approximately spanning one octave (a 2:1 frequency ratio). This characteristic facilitates the mapping of frequencies

outside this range into the visible spectrum by iterative multiplication or division by 2 until they align within the designated spectral range. In developing the Bio-Mechanical Poet, we utilized the HSV color space (Hue, Saturation, Value) to associate brain frequencies with specific color values. The hue was determined using the aforementioned octave shifting technique. Meanwhile, the value component was derived from the amplitude of the spectral peak, and saturation was calculated based on the average harmonicity between the peak and other spectral peaks.

We employ harmonic matching to align brain spectral peaks with the spectral peaks of both emission and atmospheric phenomena. Being a common technique in spectral analysis and integral to music theory, harmonic matching allows us to measure the distance between one peak and the (sub-)harmonics of another peak. We then threshold this distance to only consider close matches within a given tolerance. As (sub-)harmonics can naturally be extended outside the native frequency range of a given peak, this algorithm provides a fast yet effective way to match frequencies across different domains.

The identification of elements, planets and colors is performed every 20 to 40 seconds, leaving the user enough time to take in the audiovisual poetic scene generated from these symbols.







Figure 2: **System Implementation.** Screenshots from the three software frameworks used to implement the Bio-Mechanical Poet: **goofi-pipe (top)** implements the main EEG feature extraction (left group), secondary feature extraction (top group), matching algorithm and symbolic assemblage (bottom group; only prompt generation and text-to-speech). **TouchDesigner (middle)** is running real-time StreamDiffusion-based image generation seeded by the webcam and using prompts generated by LLMs inside goofi-pipe. A new image is generated roughly 5 times per second. TouchDesigner also renders the poetry onto the images and performs visual post-processing according to secondary EEG features. **Ableton Live (bottom)** is generating music from EEG features using the Biotuner plugin, which receives the EEG features from goofi-pipe and converts them into chords and rhythms.

Symbolic Assemblage

In the last step of our visuo-poetic pipeline we assemble the symbols that the Matching Algorithm detected in the user's brain signals into visual and poetic fragments. This component leaves several parameters that can be adjusted during the interaction with the Bio-Mechanical Poet and which will be explained alongside each segment.

The emergence of generative text-to-image diffusion AI models in recent years has paved the way for the creation of highly detailed images that show impressive levels of adherence to the textual description (prompt) in near real-time. To bridge the gap between symbols and a descriptive textto-image prompt we employ a large language model (LLM), another type of generative AI focused on language production. The LLM is automatically prompted by our pipeline to write a text-to-image prompt based on the symbols from the previous step. We can configure on the fly which symbols (element, planet, color or any combination of the three) are passed to the LLM, and select from a list of predefined LLM prompts to augment the symbols coming from brain signals. The different LLM prompts allow to specify a general setting (e.g. generic, photo-realistic, animals, mythology, ...) based on preference.

While the prompts are only updated once per new set of symbols (every 20-40s), we utilize recent advancements in the acceleration of diffusion algorithms, namely StreamDiffusion (Kodaira et al. 2023), to update the displayed image roughly 5 times per second. The image generation process is seeded with a live webcam feed (image-to-image), creating a mirror-like image of the user transformed by the prompt. We optionally support generating images without the webcam by seeding the image-to-image model with a slice of a 3D Simplex noise texture that slowly moves in the third dimension, leading to coherent evolution of the generated images over time.

We additionally generate a new line of poetry with each new set of symbols. This either follows the text-to-image prompt, i.e. by tasking the LLM to write poetry based on the image prompt, or is generated directly from the symbols. We display each new line of poetry on top of the generated images for a few seconds and also play generated speech using a text-to-speech AI model.

All steps in our pipeline up to and including prompt generation are implemented in goofi-pipe (Figure 2, top), while image generation and visual post-processing (frame interpolation, overlaying text, ...) is handled in TouchDesigner (Figure 2, middle). The communication of text prompts and secondary EEG features to TouchDesigner is implemented using the Open Sound Control (OSC) protocol. Secondary features are also used as control parameters for the generated visuals. Specifically, the theta-over-alpha ratio which can be used as an index of hypnagogic states and was previously employed in neurofeedback studies to enhance creativity (Boynton 2001; Batty et al. 2006), is communicated to TouchDesigner to control the saturation of the generated images. We employ OpenAI's gpt-4 LLM for text-to-image prompts and for poetry generation, stability.ai's Stable Diffusion Turbo (sd-turbo) inside the StreamDiffusion framework for image generation, and OpenAI's tts-1-hd model for text-to-speech. Users can select any of OpenAI's GPT models according to their preference. We additionally maintain the option to replace external API services (LLM and text-to-speech) with local open-source models (e.g. Llama 2, Mistral, ...) using the *llama.cpp* inference framework, enabling usage of the Bio-Mechanical Poet on a single laptop (with a strong GPU) without the need for an internet connection.

Music Generation

The music generation component follows the feature extraction step and implements a generative musical experience by deriving chord progressions and rhythmic structures from the EEG's spectral peaks. The architecture of spectral peaks in biological signals is known to be associated with different mental states (Klimesch 2018), and therefore provide an interesting correlate for music generation. Chords are constructed by pitch-shifting the EEG peaks and can be played using any desired virtual instrument. The arithmetic ratios of spectral peaks are used to construct Euclidean rhythms, which correspond to a set of hits equally distributed within a specific number of pulses. In the present case, the largest numbers of the frequency ratios are used to identify the number of pulses, and the smallest numbers to determine the number of hits. Hence, every pair of frequencies can be associated with a specific Euclidean rhythm. Chords and rhythms information is sent from goofi-pipe to Ableton Live (Figure 2, bottom) using the OSC protocol. Musical information is flexibly sonified in Ableton using a dedicated Max4Live toolkit, accessible at github.com/antoinebellemare/meme.

Experiences and Outcomes

The Bio-Mechanical Poet unfolds as an immersive exploration of the interplay between brain states, generative AI, and artistic expression. Users embark on a unique audiovisual and poetic journey, where their subjective experiences intertwine with abstract symbols and metaphorical narratives. The system orchestrates a dynamic flow of images, soundscapes, and poems, each element responding in realtime to the user's brain dynamics. See Figure 3 for an illustrative example sequence of a visuo-poetic narrative generated by the Bio-Mechanical Poet. In this section we explore the interactive aspect of the system and focus on the experience of "being a part of the artwork" from the perspective of the user.

Interaction with the system is designed for a single user who is equipped with an EEG headset. The installation time for the device varies depending on the specific equipment, typically ranging from a few seconds to a couple of minutes for more sophisticated EEG systems. Users have the option to tailor the output of the Bio-Mechanical Poet by selecting a specific style for the generation of images and poetry (refer to Section Symbolic Assemblage) or to operate the system in its standard configuration. Once prepared, the user engages with the experience, which entails auditory, visual, and poetic outputs derived from their neural activity. The narrative framework of our system progresses at intervals



Figure 3: **Illustrative example of adaptive narrative structure.** Images generated by StreamDiffusion (*Stable Diffusion Turbo*) based on brain-derived prompts formulated by *GPT-3.5 Turbo* alongside AI poetry (*GPT-4*) written to match the visual scenes.

of 20 to 40 seconds, updating the archetypal scene accordingly. While the overarching narrative advances gradually, the imagery is updated several times per second, fostering a dynamic experiential landscape within each narrative segment. Furthermore, when configured to use webcam images as the seed for image generation, the system affords the user a mirror-like engagement with the visual scene.

The concept of agency, i.e. the subjective feeling of power or control over the outcome of a process, is highly relevant in the context of interactive art. It is crucial for the Bio-Mechanical Poet to evoke a feeling of agency in order to facilitate the identification of the user with the generated audiovisual experience and narrative. It is our aim to guide the user into a state of reflection in which they see parts of themselves represented in the generated media. Through the use of a complex processing pipeline involving brain data and sophisticated AI algorithms we intentionally create a powerful setting reminiscent of a mind-reading device. Though the Bio-Mechanical Poet is **not** reading minds, the system draws the user into a state of self-revelation and guided introspection. Our system does not aim to accurately infer the cognitive or mental state of the user; instead, it is designed to evoke the sensation of being connected to such a device. The potential of such settings, termed "neuroenchantment", was explored by Ali, Lifshitz, and Raz (2014), demonstrating how sham neurofeedback can significantly influence beliefs about an experiment's efficacy. Furthermore, we do not instruct users to interact or interpret the experience in any certain way but rather encourage a free and personal exploration. The system is designed to generate a purely descriptive unfolding of archetypal scenes in an immersive audiovisual poetic environment and not impose an interpretation on the users. This follows the idea that art should function as a mirror for self-discovery, prompting personal reflection through open-ended forms rather than imposing external narratives.

Expanding on the concept of agency, we have identified a distinction between two variants of agency across different scales of interaction with the Bio-Mechanical Poet. On a short time scale (within tenths of seconds to seconds), users experience what we call Embodied Agency by using secondary brain features (Sections Feature Extraction and Symbolic Assemblage), such as a neurophysiological index of hypnagogia, to alter the presentation of images (e.g. desaturate the image if the hypnagogia index is low). This immediate change in visual appearance reflects and enhances the changes in subjective perception induced by hypnagogia, thus leading to a sense of control over the system stemming from internal changes imperceptible to bystanders. The same principle can be applied to interaction through the webcam, linking one's embodied movements, posture and expressions to the transformed archetypal representations.

Another type of agency, coined *Narrative Agency*, is related to the feeling of coherence with respect to the generated narrative. Through identification with perceptual content as a result of the system design of the Bio-Mechanical Poet and Embodied Agency, some users have reported gaining a sense of meaning from the experience (e.g. by being reminded of prior memories, dreams, relationships). The emergence of meaning amplifies the perceived connection with the system, thus creating a positive feedback loop reinforcing the significance of the experience.

Discussion

The Bio-Mechanical Poet is a bio-adaptive audiovisual poetic experience that harnesses the synergistic potential of LLMs and diffusion models to guide the emergence of selfreflective narratives. It utilizes brain signals to navigate a multi-modal latent space, thereby encouraging users to engage with and interpret poetry alongside complex visual and auditory stimuli. Poetry serves as a potent medium of linguistic expression, notable for its ability to evoke vivid imagery and its reliance on semantic ambiguity. Our design aims to produce sensory feedback subject to multiple interpretations, aiding users in crafting a personal and coherent narrative through sequential images and verses. In this process, users are indirectly shaping a self-referential tale by deciphering the latent transformations prompted by their physiological signals. This fluid circulation between first-person experience and third-person perspective echoes the notion of generative passages (Ramstead et al. 2022) and may contribute to a form of agency that emerges from human-machine interaction. Notably, self-referential narratives have been suggested as foundational to creative behaviors (Milthorp 2003), implying that systems like the Bio-Mechanical Poet may help in stimulating creative cognition.

Recent progress in generative AI have been proposed as a methodology to simulate the altered perceptual experiences typical of psychedelic states, thereby effectively modifying subjective experiences (Suzuki et al. 2017; Kitson, DiPaola, and Riecke 2019; Glowacki et al. 2022). Psychedelic-like states have been suggested to enhance creativity by inducing a state of cognitive flexibility, allowing for a wider range of remote associations (Sessa 2008). The Bio-Mechanical Poet embodies this research trajectory by dynamically generating dream-like audiovisual poetry that may precipitate cyberdelic states – conceptualized as mindmanifesting technologies (Hartogsohn 2023).

In a nutshell, the Bio-Mechanical Poet provides the users with a canvas for self-reflection, merging the sense of control in creating personal meanings with the possibility of changing perceptions through biofeedback. The narratives generated by our system exhibit an archetypal nature allowing for the manifestation of inner worlds within immersive media and facilitate the transition of information from the subconscious into the conscious mind. Akin to generating narratives using Tarot cards (Sullivan, Eladhari, and Cook 2018) the Bio-Mechanical Poet intends to build on archetypal imagery, in this case embedded in latent representations of LLMs and image diffusion AI models.

Future Directions

There are multiple research avenues that would be worth exploring in order to refine the system's technological foundation and extend its applicability and therefore our comprehension of how biofeedback can intersect with digital artistry to generate novel forms of expression. A key area for future investigation is the development of more sophisticated models for interpreting EEG data. Incorporating EEG foundation models (Chen et al. 2024; Cui et al. 2024) could significantly improve the system's ability to accurately interpret and respond to a user's brain states. This would enhance the precision of the biofeedback mechanism while enabling a more nuanced mapping of these states to symbolic representations and artistic expressions, thereby enriching the depth and diversity of the generated content.

The concept of cyberdelic experiences, where digital technologies induce altered states of consciousness similar to those experienced with psychedelics, offers a fascinating area for experimental research. Future studies could investigate how systems like the Bio-Mechanical Poet can be optimized to induce these states, examining their potential to enhance creativity, cognitive flexibility, and emotional wellbeing. Such research could contribute to the emerging field of digital therapeutics, providing insights into how technology can be leveraged to achieve specific psychological outcomes.

The scalability and flexibility of the Bio-Mechanical Poet opens up possibilities for reaching larger audiences and adapting the system for various contexts. Real-time diffusion techniques could be applied to short films or interactive installations, offering users the opportunity to explore parallel narratives in group settings. Additionally, developing the system as a poetic multi-modal assistant could extend its applications to educational, therapeutic, and recreational domains, making the benefits of this unique integration of biofeedback and AI accessible to a broader audience. As part of our strategy, we plan to make the system open access and widely available, which we hope will generate a wealth of use cases and feedback that further refine our pipeline.

Conclusion

The Bio-Mechanical Poet is a novel interactive system that combines tools from several emerging streams in the fields of computational creativity, generative AI and biofeedback. We leverage the experiences of embodiment and agency in a multifaceted way by incorporating physiological signals from the user in the generation of immersive audiovisual poetic scenes, thereby tailoring a unique and highly symbolic self-referential canvas. Through the real-time incorporation of biophysiological signals, our system highlights the centrality of the user's subjective experience to an art piece. Thus, it is tempting to see this bio-adaptive experience as an engagement with the self on an intimate level, sparking the idea of a dance in the shared latent space between mind and machine.

In essence, the Bio-Mechanical Poet stands as an immersive audiovisual playground where brain signals and generative AI converge, crafting a realm where interactions become reflections of the self. This fusion exemplifies how the integration of biological inputs and artificial intelligence can redefine the boundaries of creative expression and personal introspection.

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