7. Claims

1. **A sensorimotor training system** for inverted visual feedback adaptation, **comprising**:
2. at least one **visual inversion device** configured to alter a user's view of the environment by inverting the visual field upside-down relative to normal orientation;
3. one or more **interaction devices** enabling the user to perform manual tasks in response to what is viewed (including a **handheld pointing apparatus** for indicating targets or a controller for input in a virtual environment);
4. a **computing unit** operatively connected to said visual inversion device and interaction devices, the computing unit being programmed to present one or more training tasks to the user and to receive and analyze user performance data during those tasks;
5. an **adaptive control module** in the computing unit that dynamically adjusts parameters of the training tasks based on the user's performance in order to progressively challenge the user;
6. wherein the system further includes a **feedback module** that provides sensory feedback to the user during the tasks, the feedback module comprising at least visual or auditory feedback cues, and optionally **haptic feedback devices** worn by or attached to the user to deliver tactile stimuli;
7. and wherein the training tasks are configured to require the user to coordinate physical movements with inverted visual inputs, thereby inducing sensorimotor adaptation.

8. The sensorimotor training system of claim 1, **wherein** the visual inversion device comprises a pair of **optical inversion goggles** worn on the user's head, the goggles containing optical elements that flip the incoming image vertically (and optionally horizontally), and **further comprising** a handheld **laser pointer** or stylus that the user uses to interact with real-world targets while wearing said goggles, such that the user sees their environment inverted through the goggles and must manipulate the pointer to perform tasks on physical targets.

9. The sensorimotor training system of claim 1, **wherein** the visual inversion device comprises a **virtual reality (VR) headset** and associated software, the software rendering a virtual environment to the headset's display with an inverted orientation relative to the user's head movements, and **wherein** the system includes motion tracking sensors to capture the user's hand or controller movements, enabling the user to interact with **virtual targets or objects** in the inverted virtual environment as part of the training tasks.

10. The sensorimotor training system of claim 1, **wherein** the visual inversion device comprises an **augmented reality (AR) display** providing a live video feed of the real world to the user with the image digitally inverted, the AR display being either a mobile device with a camera or a head-mounted pass-through AR headset, and **wherein** the user interacts with overlaid virtual elements on said inverted feed via a touchscreen input or gesture recognition as part of the training tasks.

11. The sensorimotor training system of claim 1, **wherein** the system further comprises an **eye-tracking sensor** configured to monitor the user's eye gaze and/or pupil response during the training tasks, and **wherein** the adaptive control module utilizes metrics

derived from eye-tracking – including gaze reaction time to targets, fixation stability, or indicators of visual strain – to adjust task difficulty or provide targeted feedback to the user in real time.

12. The sensorimotor training system of claim 1, **wherein** the system further comprises one or more **wearable haptic feedback devices** selected from the group consisting of: haptic gloves, wrist or arm bands with vibratory actuators, haptic vests or belts, and combinations thereof; **wherein** the feedback module is configured to activate said haptic devices in response to user performance conditions – including providing tactile cues indicating directional guidance or error signals when the user's movement deviates from a desired trajectory, and providing distinct tactile reward signals upon successful task completion.

13. The sensorimotor training system of claim 1, **wherein** the computing unit includes a **scoring and performance tracking module** that assigns quantitative performance metrics to the user's task results, calculates scores or success rates, and displays or otherwise communicates these metrics to the user, thereby gamifying the training experience and motivating the user through instant performance feedback.

14. The sensorimotor training system of claim 1, **wherein** the training tasks are organized into a **multi-level game format** with increasing difficulty, and the system maintains a **persistent virtual environment or canvas** that retains user-generated input or progress across multiple sessions – allowing the user to see cumulative results of their actions (including drawings made, levels completed, or targets hit over time) and enabling longitudinal tracking of improvement.

15. The sensorimotor training system of claim 1, **wherein** the computing unit is programmed with multiple **operational modes**, including at least: (a) a guided training mode in which instructional cues and assistive feedback are provided to the user during tasks, (b) a testing or evaluation mode in which the user performs tasks without assistance to assess their adaptation level, and (c) a **competitive or multiplayer mode** in which performance data from two or more users are compared or shared in real time within a common task or game scenario.

16. The sensorimotor training system of claim 9, **wherein** in the multiplayer mode two or more instances of the system are networked to allow **simultaneous training** of multiple users, and the system includes a **comparative feedback loop** such that each user receives feedback about the other user's performance (including score, time, or task progress) during or after each task, thereby creating a competitive or collaborative dynamic that encourages user engagement and effort.

17. The sensorimotor training system of claim 1, **wherein** the system is configured for use in **vision therapy for amblyopia**, such that the visual inversion device is adapted to present different visual stimuli to each of the user's eyes – for example, providing an inverted or lower-clarity image to the dominant eye and a normal or higher-clarity image to the weaker (amblyopic) eye – thereby encouraging the user's brain to utilize input from the weaker eye during training tasks to improve binocular vision and visual acuity.

18. The sensorimotor training system of claim 1, **wherein** the system is configured for **neurological rehabilitation of motor function** in patients recovering from stroke or similar conditions, **wherein** the training tasks emphasize use of an affected limb under inverted visual feedback, and the computing unit's performance tracking module records rehabilitation metrics over time selected from: range of motion, accuracy of limb movement, reaction time, and error rates, such that improvements in these metrics indicate regained sensorimotor coordination in the patient.

19. The sensorimotor training system of claim 1, **wherein** the system is adapted for **developmental sensorimotor training** in children or individuals with neurodevelopmental disorders, **wherein** the training tasks are presented in a playful, game-like format with simplified visuals and rewards, and the adaptive control module is tuned to introduce inversion and challenges very gradually according to the user's tolerance, thereby improving the user's hand-eye coordination, spatial awareness, and cognitive adaptability in a manner suited to their developmental level.

20. The sensorimotor training system of claim 1, **wherein** the computing unit further comprises a **data analysis module** that aggregates and analyzes user performance data across a plurality of training sessions, generating analytics outputs such as trend graphs, progress summaries, or skill assessments, and optionally utilizes machine learning algorithms to identify patterns in the user's errors or successes; **wherein** the adaptive control module can utilize insights from said analysis to personalize future training tasks (for example, targeting persistent weak spots in performance or predicting an optimal challenge level for the next session).

21. The sensorimotor training system of claim 1, **wherein** the degree or type of visual transformation applied by the visual inversion device is **configurable**, such that the system can apply a partial inversion or rotation of the visual field at early stages of training and progressively approach a full 180-degree inversion as the user adapts, or vary the inversion (including left-right mirror inversion or other distortions) to train the user under different transformation conditions, thereby broadening the adaptive response of the user's sensorimotor system.

22. **A method** for training a user's sensorimotor coordination under inverted visual conditions, **comprising**:
(a) presenting to the user a view of their environment or a virtual environment that is **inverted** relative to normal orientation using a visual inversion apparatus or algorithm;
(b) instructing the user to perform one or more **manual tasks** in response to what is seen in the inverted view, the tasks requiring coordination of the user's hand or body movements with the visually perceived targets or trajectories;
(c) during the user's performance of the tasks, **capturing performance data** including the user's accuracy, timing, and response patterns, and optionally capturing the user's **eye-tracking data** indicative of where the user is looking;
(d) providing the user with **feedback** based on their performance, including at least one of: visual feedback (such as highlighting a target when hit or displaying a score), auditory feedback (sounds indicating success or error), and tactile feedback via haptic devices indicating guidance or results;

(e) **adapting the difficulty** or parameters of subsequent tasks in real-time or between training sessions, based on the captured performance data, such that if the user's performance exceeds a predetermined success criterion the tasks are made progressively more challenging, and if the user's performance falls below a predetermined threshold the tasks are made easier or additional assistive cues are provided;
(f) repeating steps (a) through (e) in a series of training sessions, thereby inducing the user's sensorimotor system to gradually adjust and improve under inverted visual feedback conditions.

23. The method of claim 16, **wherein** in step (a) the view is presented through **optical inversion goggles**, and in step (b) the user performs tasks involving interacting with **physical targets** in the real environment (such as aiming a laser pointer at fixed or moving targets on a surface, or tracing shapes on a board), such that the method is implemented in a physical training scenario with real-world props.

24. The method of claim 16, **wherein** in step (a) the view is presented via a **virtual reality headset** which renders a computer-generated environment, and the inversion is achieved by rotating the virtual camera viewpoint, and in step (b) the user's manual tasks include interacting with **virtual objects or game elements** within said computer-generated inverted environment (using tracked controllers or hand-tracking), such that the method is implemented in a virtual reality training scenario.

25. The method of claim 16, **wherein** in step (a) the view is provided through a **video see-through augmented reality device** that captures the real environment on camera and displays it to the user after inverting the image, and in step (b) the user interacts with **augmented content** superimposed on the inverted view (via touch input on a mobile device screen or gestures in an AR headset), thereby performing tasks that blend real and virtual elements under inverted visual feedback.

26. The method of claim 16, **wherein** step (c) includes capturing **eye-tracking metrics** of the user, and step (e) includes adapting the difficulty based on said eye metrics, including for example: increasing task speed or complexity when the user's gaze reaction times shorten indicating improved adaptation, and providing visual or audio prompts when prolonged search or missed fixations indicate the user is struggling to locate targets in the inverted view.

27. The method of claim 16, **wherein** step (d) includes delivering **haptic feedback cues** to the user through wearable devices, the cues comprising patterned vibrations or pressures that indicate to the user either the direction of error (prompting the user to correct their movement during the task) or the occurrence of a success (rewarding the user upon correctly completing a task), and wherein the intensity or frequency of such haptic feedback is adjusted over time so as to give the user greater independence as their skill improves.

28. The method of claim 16, **wherein** the method is applied in a **multi-user setting**, further comprising the steps of:
– connecting two or more users each performing the method under inverted visual conditions;

– synchronizing the tasks or environment such that the users are engaging in a shared or comparative exercise (either cooperatively or competitively);
– sharing performance data between the users or to a central server in real time; and
– presenting each user with feedback about the **other user's performance** (such as relative scores, race positions, or collaborative task status), thereby creating a competitive or collaborative feedback loop that influences each user's motivation and strategy during the training.

29. The method of claim 16, **wherein** the method is utilized for **therapeutic vision training for amblyopia**, further comprising: **occluding or altering** the visual input of one eye (in particular, presenting an inverted or less clear view to the dominant eye) while presenting a normal or clearer view to the amblyopic eye during step (a), and designing the tasks in step (b) to require binocular coordination or usage of the amblyopic eye's input, such that the weaker eye is stimulated and engaged throughout the inverted vision training, thereby improving visual function in that eye over multiple sessions.

30. The method of claim 16, **wherein** the method is utilized for **post-stroke or neurological rehabilitation**, further comprising: selecting and customizing the tasks in step (b) to involve movements of a patient's affected limb or exploration of space on an affected side (for example, reaching with a paretic arm towards targets in an inverted field), and capturing rehabilitation metrics (including range of motion and accuracy with the affected limb) as part of step (c), and gradually increasing task difficulty in step (e) as those metrics improve, thereby facilitating recovery of motor control and spatial awareness in the patient.

31. The method of claim 16, **further comprising** after step (c) a step of **storing and analyzing** the performance data over a plurality of sessions, identifying trends in the user's adaptation (such as steady reduction in error angles or time savings), and generating a **progress report** or visualization for review by the user or a trainer, wherein said analysis is used to adjust long-term training objectives or to compare the user's adaptation rate with expected benchmarks.

32. A **non-transitory computer-readable medium** carrying instructions which, when executed by one or more processors of a computing device in a sensorimotor training system, cause the system to perform the steps of the method according to claim 16, thereby implementing an inverted vision training program that presents inverted visual content, tracks user interactions, adapts difficulty, and provides feedback as described.

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