

Inverted Sensorimotor Training System and Method with Physical and Virtual Embodiments and Gamification Features

Field of the Invention

This invention relates generally to sensorimotor training systems and, more particularly, to methods and apparatuses for retraining hand-eye coordination using inverted visual feedback. The invention encompasses both a low-cost, physical embodiment—comprising inversion goggles and a handheld laser pointer—and an advanced virtual embodiment that integrates a VR environment with an electronic laser pointer, persistent virtual markings, and gamification features to enhance user engagement and competitive participation.

Background of the Invention

Historically, inversion goggles have been used to study perceptual adaptation and neural plasticity, demonstrating that the human brain can relearn sensorimotor mappings under altered visual conditions. While earlier experiments used physical inversion devices, such methods lacked dynamic feedback and persistent data capture.

Recent advances in virtual reality (VR) have enabled the simulation of complex environments for training and rehabilitation. In addition, gamification has emerged as an effective means of increasing user engagement by incorporating elements such as scoring, auditory cues, prizes, and competitive tournaments. There remains a need for a system that spans both accessible, low-cost physical methods and advanced digital systems capable of detailed performance tracking and gamified interaction. This invention addresses that need by protecting both the simple combination of inversion goggles and a laser pointer and a layered VR approach with integrated sensor tracking and gamification features.

Summary of the Invention

The present invention provides a method and apparatus for retraining hand-eye coordination via sensorimotor challenges induced by inverted visual feedback. The invention has two primary embodiments:

1. **Physical Embodiment (Base Model):**

- **Components:** Inversion goggles that provide a reversed visual field and a handheld laser pointer.
 - **Operation:** The user performs tasks (e.g., drawing or writing) under the inverted visual conditions, forcing the brain to recalibrate motor control.
 - **Advantages:** Low-cost, simple, and effective for initiating sensorimotor retraining.
2. **Virtual Embodiment (Advanced Model):**
- **Components:**
 - A VR headset that digitally inverts the visual field.
 - A motion tracking system to capture the user's hand movements.
 - An integrated electronic laser pointer.
 - A persistent virtual canvas that retains markings made by the laser pointer.
 - A gamification module that integrates scoring, auditory feedback, prizes, and competitive tournament features.
 - **Operation:**
 - The user engages in sensorimotor tasks (such as tracing patterns, writing words, or drawing) in an immersive VR environment with an inverted visual display.
 - The electronic laser pointer is used to generate virtual markings on a persistent canvas, which serves as both feedback and a record of performance.
 - The gamification module provides real-time points, sound effects, and virtual prizes. It also supports competitive play by allowing users to participate in tournaments and global challenges.
 - **Advantages:**
 - Enhanced feedback and data tracking enable detailed performance analysis and progressive training.
 - Gamification elements boost user motivation and engagement, transforming the training exercise into a competitive, leisure sport with global appeal.

Together, these embodiments protect both a basic sensorimotor retraining device and an advanced, digitally enhanced system that leverages gamification to incentivize practice and participation.

Brief Description of the Drawings

(Note: The following figures are exemplary and intended to illustrate aspects of the invention.)

- **FIG. 1:** Block diagram of the physical embodiment showing the inversion goggles and handheld laser pointer.

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| Inversion Goggles |
| (Reverses Visual |
| Field: Left/Right, |
| Up/Down) |

+-----+-----+

|
V

[User]

|
V

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| Handheld Laser Pointer|
| (Low-Powered, Safe) |

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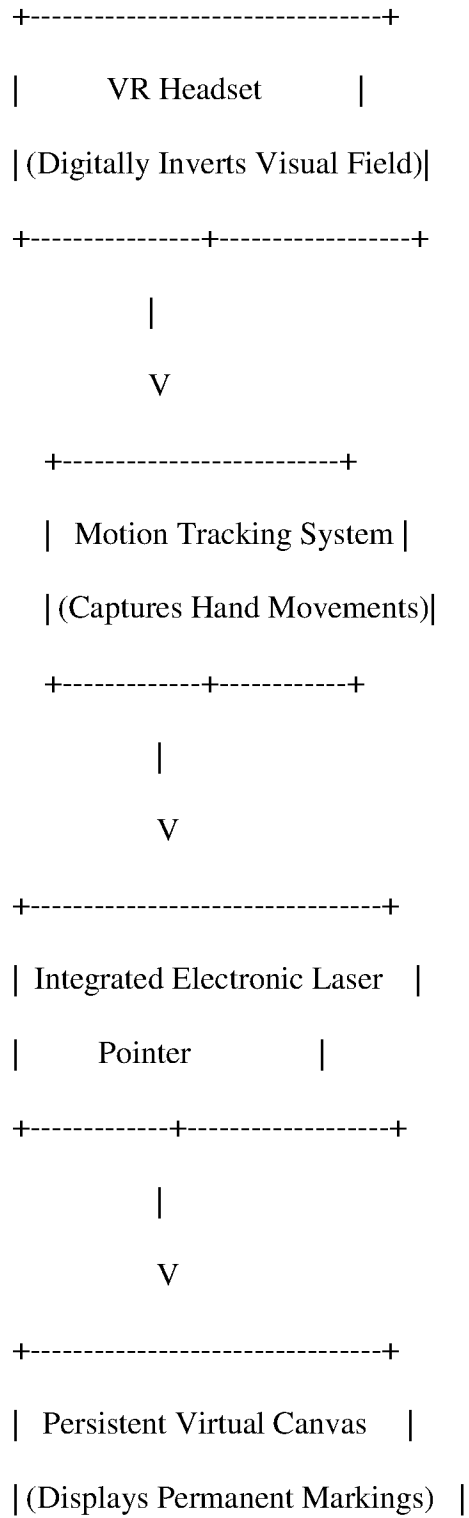
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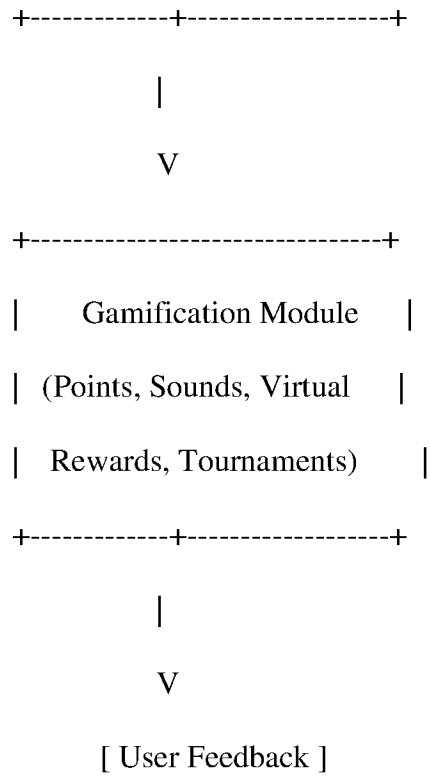
| Sensorimotor Task |
| (Drawing, Writing, |
| Tracing Patterns) |

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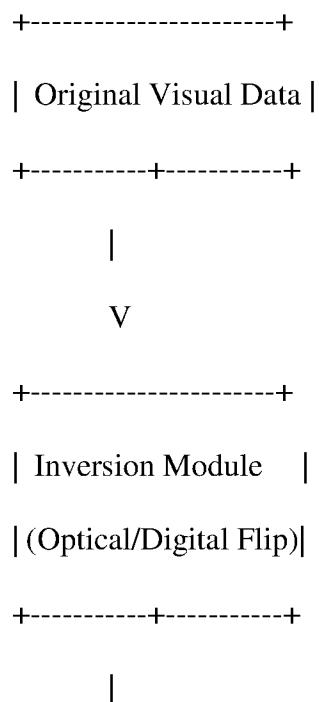
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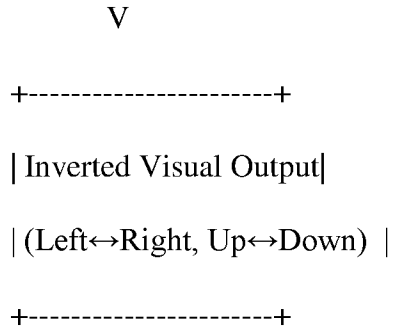
- **FIG. 2:** Block diagram of the VR sensorimotor training system, including the VR headset, motion tracking system, integrated electronic laser pointer, persistent virtual canvas, and gamification module.



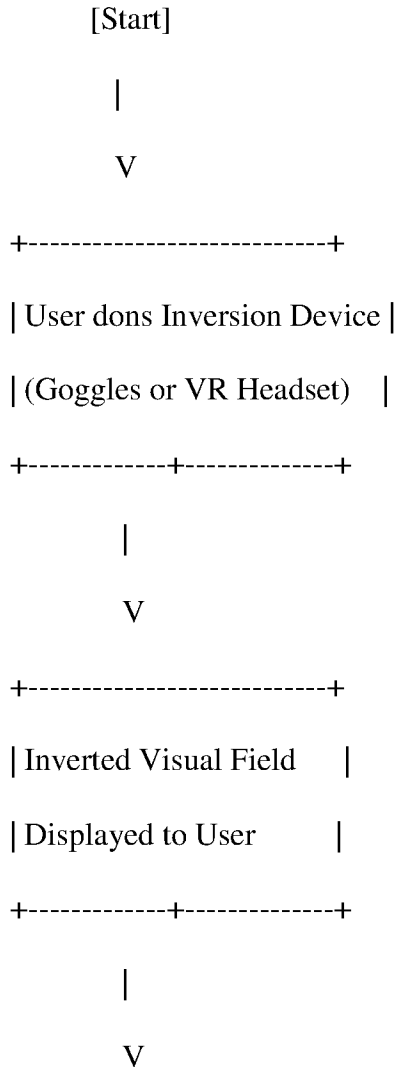


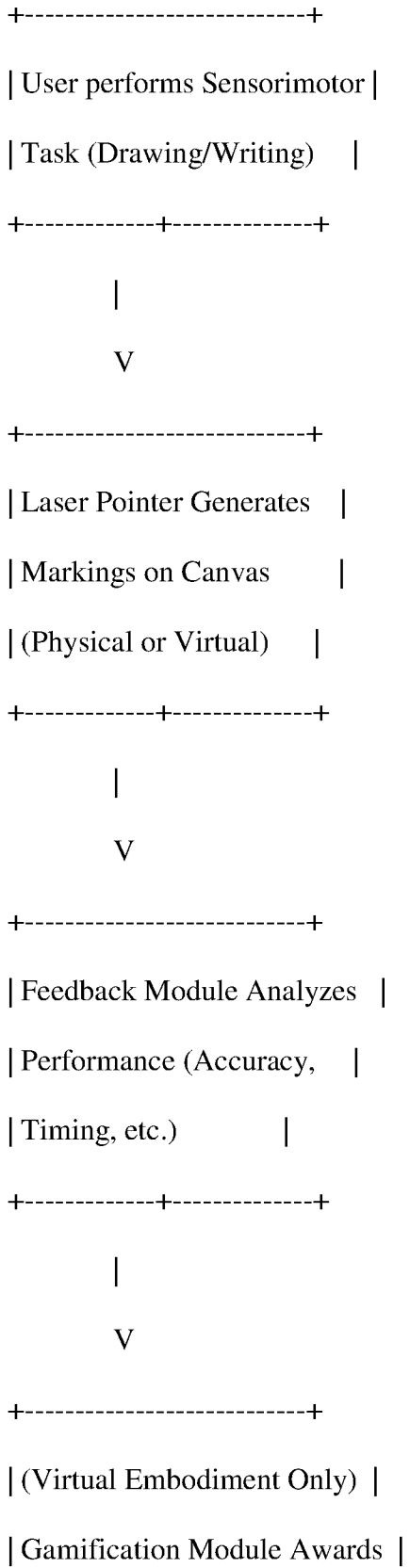
- **FIG. 3:** Schematic representation of the inversion process in both the physical and virtual embodiments.





- **FIG. 4:** Flowchart detailing the method of sensorimotor retraining, from initial user engagement through to feedback, gamification, and performance analysis.





| Points, Sounds, Rewards |

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[End/Repeat]

Detailed Description of the Invention

A. Physical Embodiment (Base Model)

1. Components:

- **Inversion Goggles:** Glasses or goggles equipped with optical or digital elements to invert the user's visual field, reversing left/right and up/down orientations.
- **Handheld Laser Pointer:** A low-powered, safe laser pointer that the user holds and directs to perform tasks such as drawing or writing on a physical or simulated surface.

2. Operation:

- The user dons the inversion goggles, thereby altering standard spatial orientation.
- The handheld laser pointer is used to perform sensorimotor tasks, challenging the user to adapt to the inverted visual input.
- This embodiment is designed to be simple, cost-effective, and accessible for initiating sensorimotor training and rehabilitation.

B. Virtual Embodiment (Advanced Model)

1. Components:

- **VR Headset:** A display device configured to digitally invert the visual field, replicating the inversion effect seen with physical goggles.
- **Motion Tracking System:** Sensors or controllers that capture the user's hand movements within the VR environment.
- **Integrated Electronic Laser Pointer:** A virtual tool controlled by the user's hand movements, which interacts with the digital environment.
- **Persistent Virtual Canvas:** A virtual surface (such as a floating wall or paper) that permanently retains the markings made by the electronic laser pointer.
- **Gamification Module:** Software that integrates elements such as:
 - **Scoring System:** Awarding points based on accuracy, speed, or complexity of the sensorimotor tasks.
 - **Auditory Feedback:** Sound effects that provide immediate, engaging feedback on performance.

- **Virtual Prizes and Rewards:** Incentives such as badges, trophies, or unlockable features.
- **Competitive Tournaments:** Features that enable users to participate in global competitions, leaderboards, and challenges, transforming the exercise into a competitive leisure sport.

2. Operation:

- The VR headset displays an inverted image, challenging the user's motor control as they perform tasks using the integrated laser pointer.
- The user's movements are captured by the motion tracking system, and the virtual laser pointer generates markings on the persistent virtual canvas.
- The gamification module analyzes performance in real time, awarding points and providing auditory feedback and virtual rewards.
- The system supports competitive play, allowing users to participate in tournaments and compare scores globally.

C. Feedback, Data Analysis, and Gamification

- **Feedback Mechanisms:**

Both embodiments may include modules that provide real-time auditory and visual cues based on task accuracy and performance.

- **Data Analysis:**

In the virtual embodiment, session data is stored and analyzed to monitor improvements, measure error margins, and track progress over time.

- **Gamification Features:**

The gamification module further enhances user engagement by:

- Awarding points and bonuses for achieving predefined performance metrics.
- Integrating sound effects and virtual rewards to motivate continued practice.
- Enabling participation in competitive tournaments and global challenges, thereby transforming the sensorimotor training into a recreational sport with widespread appeal.