Air Canvas Project: Enhancements

1. Architectural Improvements

Introduction of AirConfig Module

- Centralized all configuration settings (canvas size, colors, interaction parameters).
- Eliminated scattered constants across the codebase.
- Easier maintenance, modification, and testing.

2. User Interface Overhaul

Region-Based Color Selection (UI Header)

- Replaced old color cycling with direct color selection.
- Provides clear visual indicators for active colors.

Brush Size Controls

- Added plus (+) and minus (-) buttons on the right side of the screen.
- Live brush thickness display for real-time feedback.

Eraser Tool Upgrade

- Dedicated pink indicator for better visibility.
- More precise erasing experience.

3. Enhanced Visual Feedback

UI Separation & Indicators

- Double boundary line to separate UI from the drawing area.
- Real-time feedback for color changes, brush size, and eraser activation.

Auto-Clear Countdown

- When no hand is detected, a countdown appears before auto-clearing.
- Prevents accidental drawings left behind.

4. Advanced Eraser System

Collision-Based Erasure

- Uses collision detection to identify intersections between the eraser and strokes.
- Instead of overwriting with background color, it removes strokes from the canvas data structure.
- Two-pass rendering process:
    1. Detect eraser strokes.
    2. Identify and remove affected content strokes.
- Results in cleaner, more precise erasing.

5. Intelligent Canvas Management

Stroke Lifetime & Auto-Clear

- Auto-clears the canvas if no hand is detected for a set time.
- Each stroke records its creation time and will auto-disappear after a specified duration.
- Enables lasting drawing effects.

6. Optimized Rendering Pipeline

Performance Enhancements

- Layered rendering for better performance:
    - Create an empty canvas.
    - Identify eraser strokes.
    - Apply collision detection.
    - Render only visible strokes.
    - Use bitwise operations for efficiency.
- Improves responsiveness and visual quality.

7. Developer Experience & Error Handling

Debug Mode & Fallbacks

- Configurable debug mode for testing.
- Robust error handling:
    - If the UI header fails to load, fallback to an alternative header.
    - If no overlays are available, a basic header is generated.
- Ensures application stability even when external resources are missing.

Conclusion

The **Air Canvas** has developed into a feature-rich, gesture-controlled drawing tool through:

- Structural improvements (AirConfig, optimized rendering).

- UI enhancements (better color selection, brush controls, real-time feedback).
- Advanced tools (collision-based erasing, stroke management).
- Performance upgrades (efficient rendering, auto-clear).
- Improved developer experience (debug mode, error handling).