

SmartCut Studio Pro

Complete Extended User Guide & Technical Manual

Lossless Freeform Subject Extraction & Image Composition Software

Browser-Based Local Processing Engine

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1. Introduction & Overview

SmartCut Studio Pro is a state-of-the-art, browser-based web application designed for high-precision, loss-free subject extraction (cutout) and professional image composition. It combines advanced computer vision algorithms (powered by WebAssembly-compiled OpenCV.js and Guided Matting) with an intuitive multi-step user workflow and pixel-accurate manual refinement controls.

PRIVACY & LOCAL PROCESSING SECURITY

Unlike conventional cloud-based photo editing platforms, SmartCut Studio Pro performs **100% of its calculations locally inside your web browser**. Your private images are never transmitted, uploaded, or cached on remote servers or third-party cloud systems. This guarantees total data privacy, absolute security for personal or proprietary photography, and processing speeds that remain blazingly fast regardless of internet bandwidth.

Important Privacy Notice on Generative AI: SmartCut Studio Pro explicitly does *not* employ any Generative Artificial Intelligence (Generative AI), cloud-hosted neural network APIs, or generative diffusion models. Every edge detection, GrabCut segmentation, and matting process is governed purely by deterministic, classical computer vision mathematics, exact color-space matrix operations, and local pixel manipulation algorithms.

Key Capabilities & Features

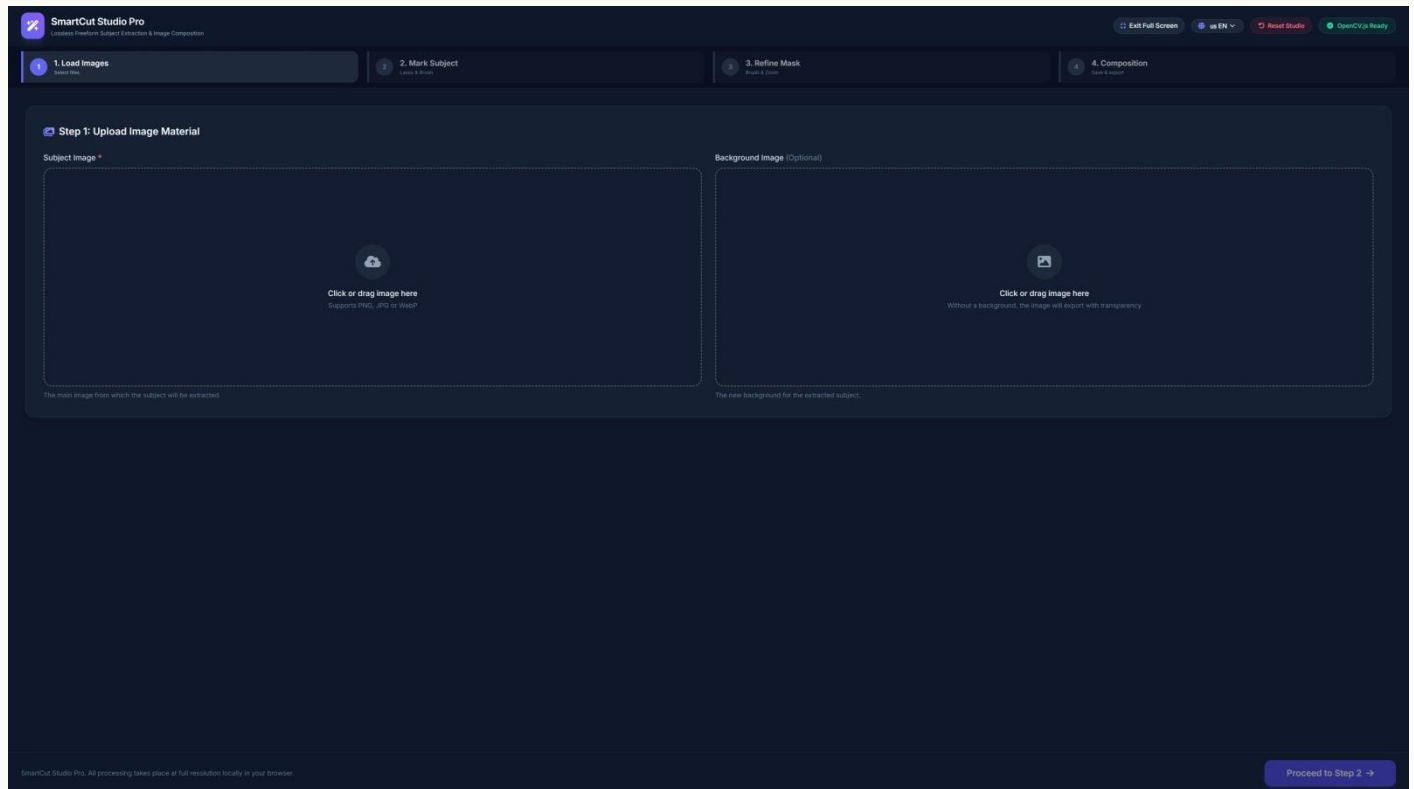
- **Lossless Full-Resolution Extraction:** High-resolution photographs (from DSLR cameras or mobile devices) are processed and exported at their original source resolution without unwanted compression artifacts or quality loss.
- **Hybrid Extraction Pipeline:** Seamless integration of user-guided GrabCut segmentation with Guided Matting to cleanly separate delicate edge details like fine hair, animal fur, feathers, glass, and translucent fabrics.
- **PNG Transparency Direct Bypass:** SmartCut Studio Pro intelligently detects images that already possess transparent alpha channels (such as pre-cut PNGs or logos), allowing users to skip manual selection steps while fully preserving existing alpha channels.
- **Full Multilingual Support:** Complete localization across 10 international languages with dynamic real-time interface switching.



- **Interactive Multi-Layer Canvas Engine:** Non-destructive composition engine supporting independent per-layer scaling, rotation, positioning, horizontal flipping, and color/lighting matching.

2. Getting Started & User Interface

The user interface of SmartCut Studio Pro is engineered for maximum operational clarity. It features a sticky top bar containing global studio controls and a linear step-by-step navigation bar that guides you through the full workflow.



Global Controls & Top Header

The top header bar remains accessible throughout all workflow steps and includes the following global functions:

- **Full Screen Toggle:** Expand the studio workspace to occupy your entire screen for distraction-free editing and maximized canvas visibility. Click the *Fullscreen* button or press the shortcut to toggle.
- **Language Switcher (10 Languages):** A built-in language drop-down allows you to switch the entire application interface on the fly without losing project progress or active canvas selections. Supported languages include:
 - 🇩🇪 Deutsch (DE)
 - 🇺🇸 English (GB/US)
 - 🇫🇷 Français (FR)
 - 🇪🇸 Español (ES)
 - 🇵🇱 Polski (PL)
 - 🇮🇹 Italiano (IT)
 - 🇯🇵 日本語 (JA)
 - 🇧🇷 Português (BR)
 - 🇳🇱 Nederlands (NL)
 - 🇨🇳 简体中文 (ZH)

- **Reset Studio:** Instantly clears all loaded images, resets all parameter sliders, clears history buffers, and returns the application state to a fresh start.
- **OpenCV Status Indicator:** Real-time status display indicating WebAssembly library initialization. An animated spinner appears during loading (*OpenCV.js is loading...*), changing to a green checkmark (*OpenCV.js ready*) once computer vision operations are ready.

Step-by-Step Linear Navigation

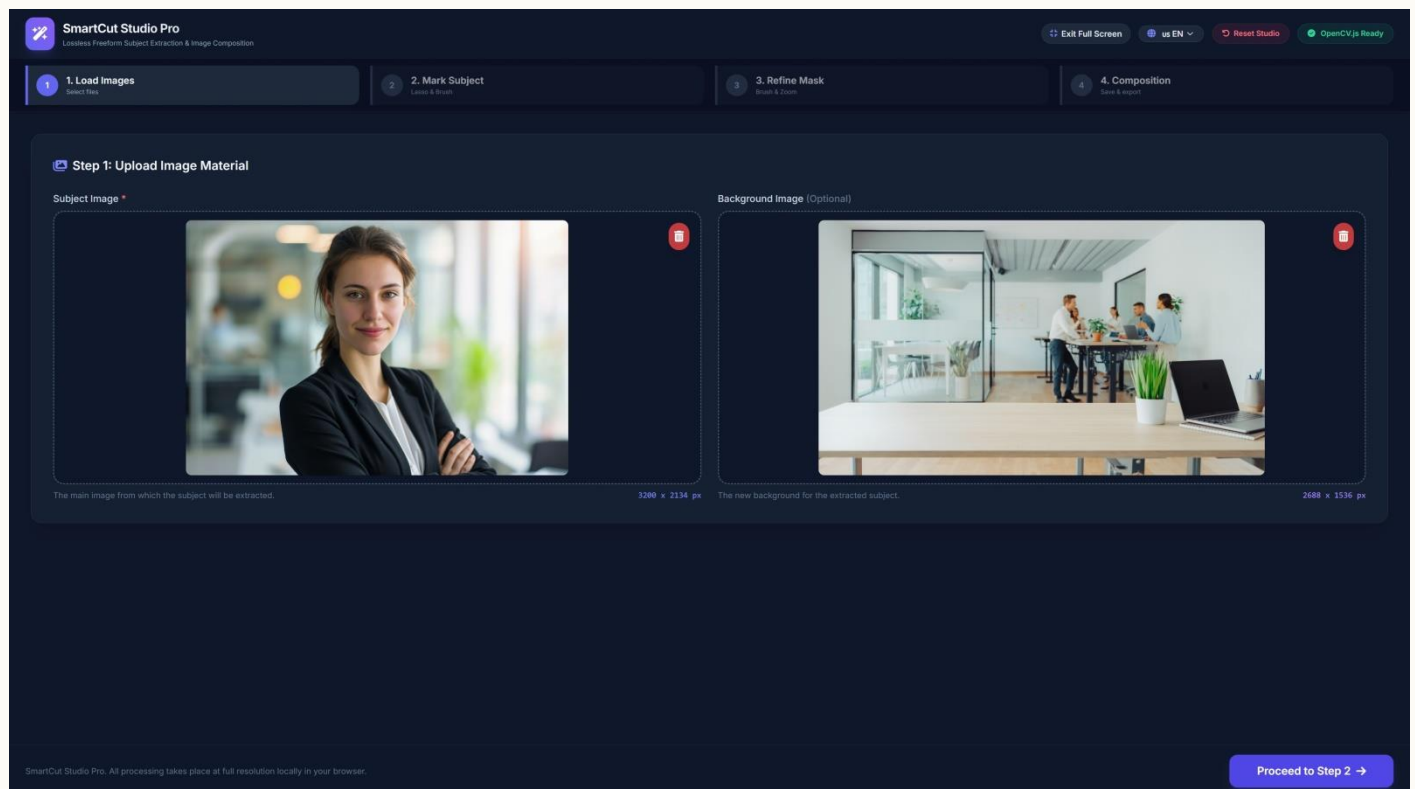
Located below the global header, the step navigation bar displays four sequential tabs. Each tab represents a distinct phase of the project:

1. **Upload Images:** Select main subject and optional background images.
2. **Mark Subject:** Outline or paint foreground subjects and cutouts using Lasso, Polygon, or Brush.
3. **Refine Mask:** Perform pixel-level manual brush corrections, edge restoration, and mask tuning.
4. **Composition:** Scale, reposition, rotate, adjust color tones, blur background, and export final PNG.

Completed steps are highlighted with green badges and can be clicked at any time to return to previous phases. Unlocked steps can be freely navigated back and forth.

3. Step 1: Uploading Image Material

In Step 1, you import your primary image material into SmartCut Studio Pro. The application features dual drag-and-drop dropzones designed for high resolution image handling.



1. Main Subject Image Upload (Required)

Click inside the left dropzone labeled **Subject Image** or drag an image file directly from your system file explorer. This is the photo containing the foreground subject, person, product, or object you wish to extract.

2. Background Image Upload (Optional)

Click inside the right dropzone labeled **Background Image** or drag a scene image into it.

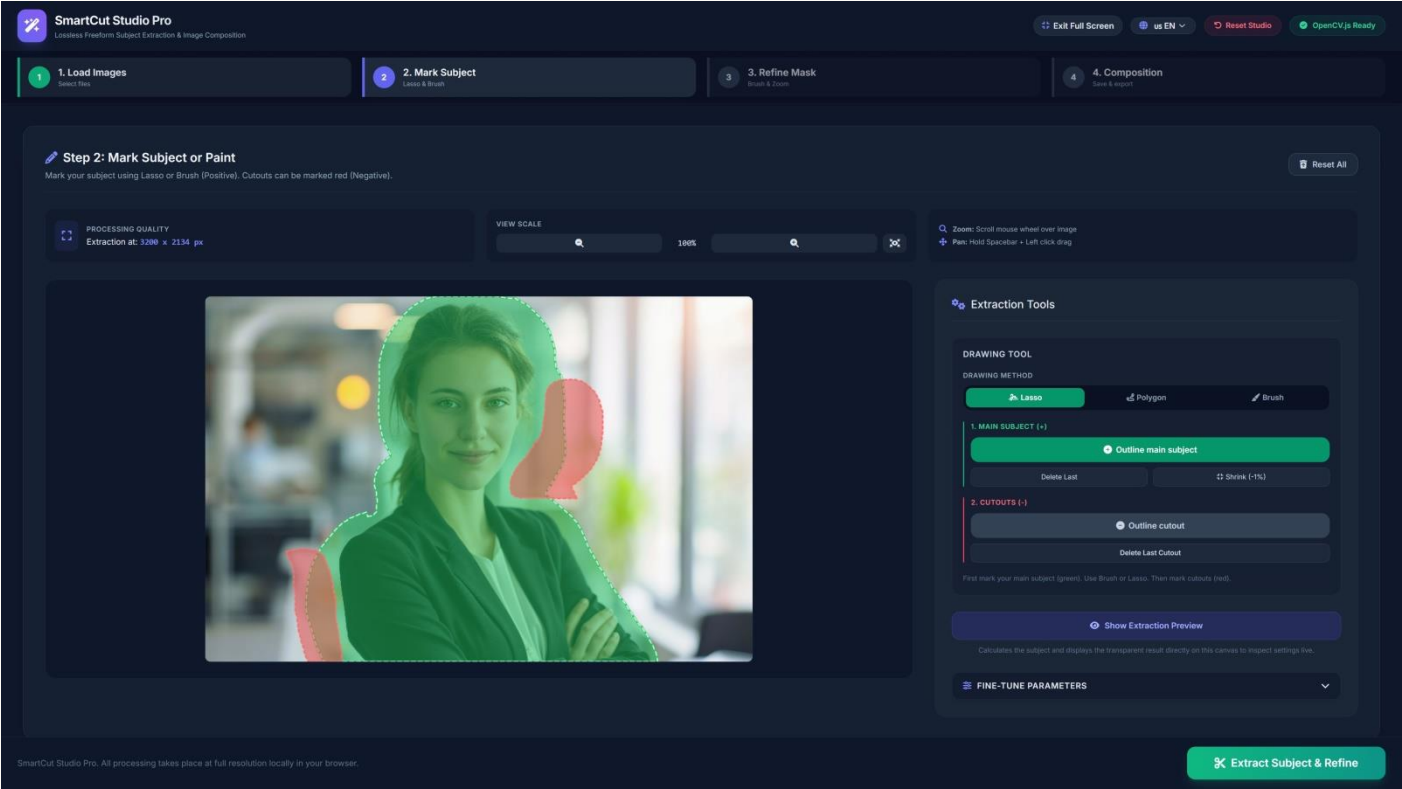
*Note: Uploading a background image is optional. If left empty, SmartCut Studio Pro will automatically render and export your extracted subject on a transparent background in **.PNG** format.*

3. Supported File Formats & Automatic Resolution Detection

SmartCut Studio Pro supports all major browser-native image formats, including **PNG**, **JPG / JPEG**, and **WebP**. Upon uploading, the software analyzes the file metadata and displays resolution badges (e.g., **3840 × 2160 px**) at the bottom of each dropzone, confirming that full original image dimensions are recognized.

4. Step 2: Marking the Subject & Interactive Cutouts

Step 2 is where you define foreground subject regions (Positive) and inner cutout holes (Negative) to guide the automated segmentation engine.



1. Selection Tools & Drawing Methods

SmartCut Studio Pro offers three versatile drawing tools in the Step 2 sidebar panel:

- **Freehand Lasso:** Click and hold down the left mouse button while drawing a continuous freehand outline around your subject. Releasing the mouse button automatically closes the shape.
- **Polygon / Point-to-Point:** Click surrounding the subject to place discrete anchor points connected by straight vector lines. Double-click or click near the starting point to complete and close the polygon chain. Ideal for geometric objects, furniture, boxes, or architecture.
- **Brush:** Paint strokes directly over subject areas. A dedicated *Brush Size* slider (1 to 300 px) appears, allowing you to quickly fill larger solid areas.

2. Positive (+) vs. Negative (-) Markings

Marking Type	Color Overlay	Purpose & Usage Guidance
Main Subject (+) <i>Positive-Marker</i>	Semi-transparent Green	Defines the area containing your subject. Rough outlines around the subject are sufficient — you do not need to trace every millimeter perfectly, as the algorithm detects actual edge boundaries.

Cutouts / Holes (-) <i>Negative-Marker</i>	Semi-transparent Red	Defines inner holes or background gaps that must be cut out (for example, the space between an arm and torso, spokes of a bicycle, or gaps in a chair backrest).
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3. Selection Control Buttons

- **Delete Last:** Removes the most recently drawn positive or negative selection stroke.
- **Shrink Lasso (-1% narrowing):** Uniformly contracts all green subject lasso outlines inward towards the object center by 1%. This allows you to quickly tighten loose selections and remove excess background area.
- **Reset All:** Clears all positive and negative markings from the workspace canvas.

4. Parameter Fine-Tuning Section

Opening the expandable Parameter Fine-Tuning panel gives you fine-grained control over the computer vision extraction pipeline:

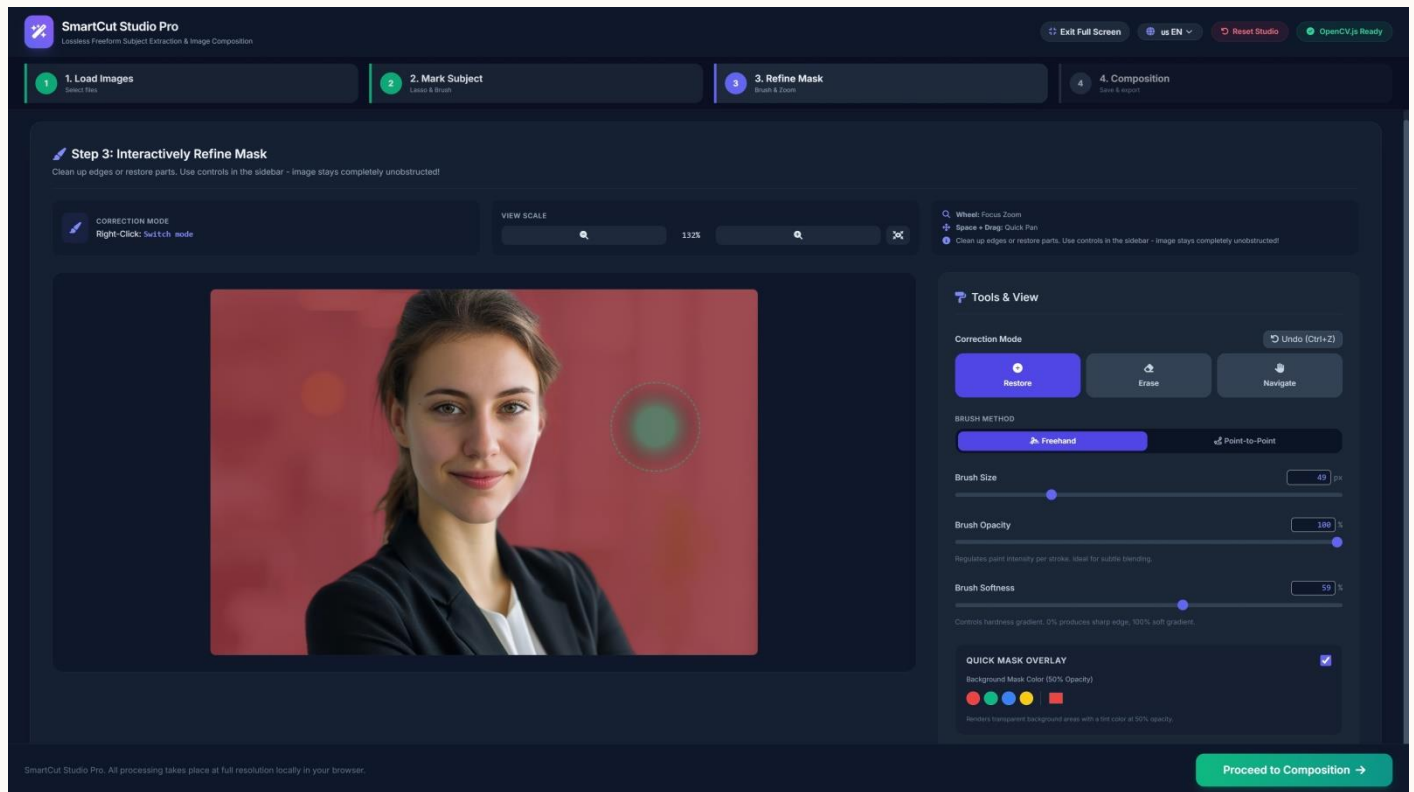
- **Inner Protection Zone (1% - 25%):** Sets the internal morphological erosion percentage. Higher values (e.g., 10%-15%) strictly protect the subject's interior core from accidental holes caused by internal color overlap with the background.
- **Edge Sharpness (0% - 100%):** Adjusts edge transition hardness during matting computations. Use high values (50%-100%) for hard-edged objects (vehicles, electronics, products); use lower values (0%-20%) for soft or organic boundaries.
- **Hair & Fine Details (1 px - 40 px):** Sets the radius for Guided Matting calculations around edge boundaries. Essential for isolating individual hair strands, fur, tree leaves, or translucent materials.
- **Border Shift (-15 px to +15 px):** Moves the outer mask boundary inward (-) or outward (+). Shifting -2 px to -5 px inward strips away unwanted color halos bleeding from the original background.
- **Edge Smoothing (0 px - 20 px):** Applies a subtle Gaussian filter to mask edges to eliminate pixelated, jagged contours for seamless background blending.

5. Live Extraction Preview & Viewport Navigation

Click **Show Extraction Preview** to run segmentation directly on the Step 2 workspace canvas. This renders the transparent result live, allowing you to test slider adjustments in real time before proceeding to Step 3.

5. Step 3: Interactive Mask Refinement

After initial automated extraction, Step 3 gives you absolute pixel-level manual control over the extraction mask through specialized paint and touch-up tools.



1. Correction Modes

- **Restore / Add (Green):** Paints missing foreground details back into the subject (e.g., a missed finger, hair tuft, or clothing edge).
- **Erase / Remove (Red):** Erases leftover background pixels or unwanted edge halos that were not caught by automated segmentation.
- **Navigate / Pan (Yellow):** Moves the canvas viewport smoothly across the screen without placing paint marks.

2. Brush Customization Controls

All brush parameters feature synchronized numeric inputs and range sliders for precise adjustments:

- **Brush Size (1 to 200 px):** Adjusts brush diameter for fine edge detail work or broad surface restoration.
- **Brush Opacity (1% to 100%):** Regulates paint application density per stroke. Use lower values (20%-50%) for soft blending around sheer clothing or glass.
- **Brush Softness (0% to 100%):** Defines radial edge feathering. 0% produces a sharp stencil edge; 100% produces a soft gradient.

- **Point-to-Point Mode:** Connects sequential brush clicks with perfectly straight paint strokes. Double-click to terminate the stroke chain.

3. Quick Mask Overlay & Contrast Tinting

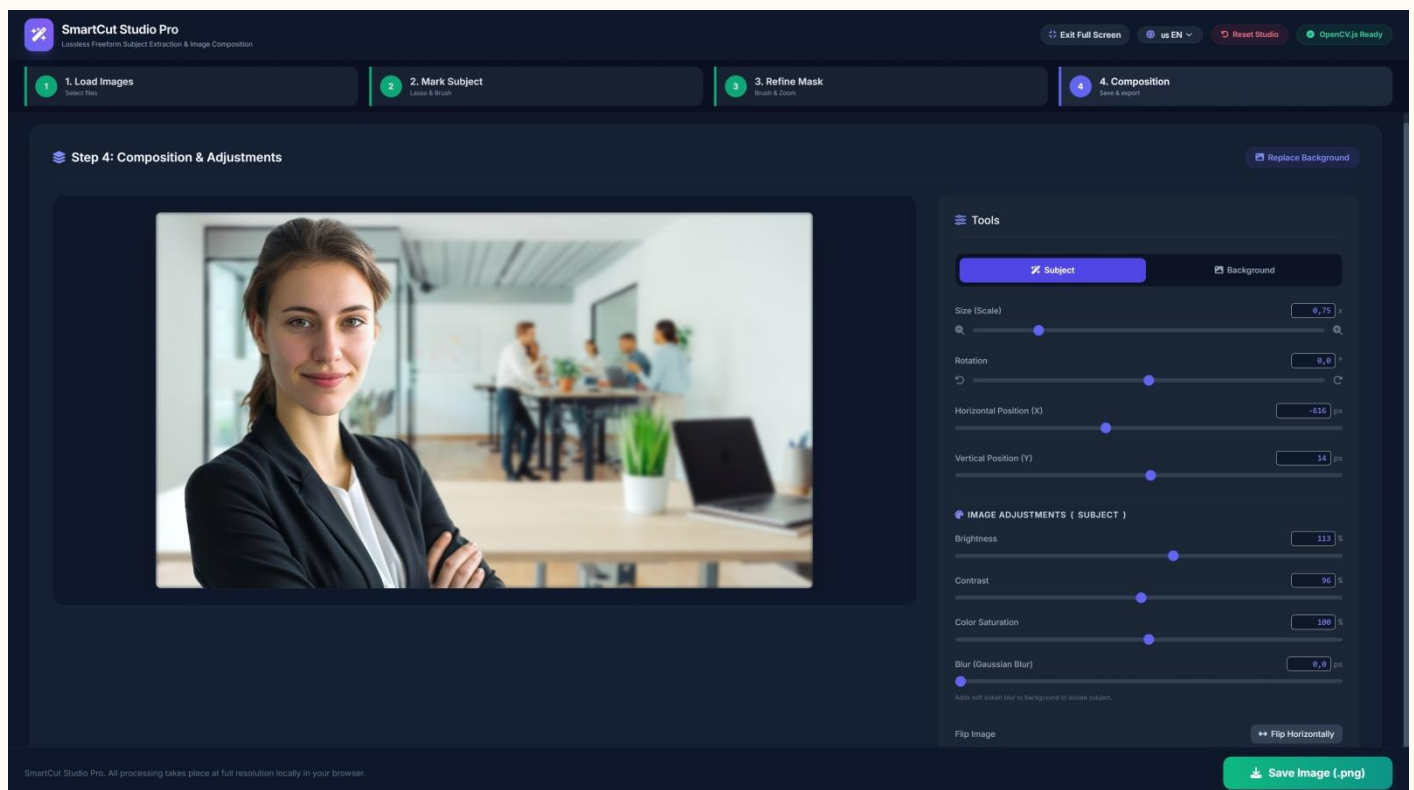
When working on light subjects or transparent edges, boundary visibility can be difficult. Enable **Quick Mask Overlay** to render transparent background areas with a 50% semi-transparent contrast color (Red, Green, Blue, Yellow, or a custom color picker).

4. History Stack & Undo

SmartCut Studio Pro maintains an internal 20-state undo history buffer. Click **Undo** or press on your `Ctrl + z` keyboard to instantly revert manual brush modifications

6. Step 4: Composition & Final Image Adjustments

In Step 4, your extracted foreground subject is composite-layered over your chosen background scene (or a transparent canvas). Here you can fine-tune placement, scaling, and color harmony.



1. Layer Target Selection

Use the top toggle buttons **Subject** and **Background** to select which layer receives active transformation and color adjustments.

2. Interactive Canvas Controls & Transformations

- **Direct Canvas Dragging:** Click and drag anywhere on the main preview canvas to move your selected layer position in real-time.
- **Mouse Wheel Scaling:** Scroll your mouse wheel over the canvas to scale the active layer up or down smoothly.
- **Scale Slider (0.05x to 4.00x):** Precise numerical scale control.
- **Rotation Slider (-180.0° to +180.0°):** Rotates the layer to align angles or correct horizon lines.
- **Position Offsets X & Y (-2000 px to +2000 px):** Pixel-exact horizontal and vertical placement sliders.
- **Horizontal Flip:** Instantly mirrors the active layer horizontally to match light direction.

3. Non-Destructive Color & Lighting Adjustments

To achieve realistic image synthesis, lighting and color tones must match between the foreground subject and background layer. SmartCut Studio Pro provides independent non-destructive controls for both layers:

Adjustment Control	Range	Description & Creative Application
Brightness	0% - 200%	Adjusts layer light intensity to match ambient scene lighting.
Contrast	0% - 200%	Enhances or softens highlight and shadow separation.
Color Saturation	0% - 200%	Boosts color vibrancy or reduces saturation to match muted tones.
Gaussian Blur	0.0 to 50.0 px	Applies a soft focal blur to the background layer, simulating a shallow depth-of-field (bokeh effect) captured by photographic lenses.

7. Exporting & Saving Your Work

When your image composition is complete, click **Save Image (.png)** in the sticky bottom bar to export the rendered high-resolution image.



1. Modern System Save File Picker API

On modern desktop web browsers (Google Chrome, Microsoft Edge, Opera), SmartCut Studio Pro utilizes the native *FileSystemAccess API* (`window.showSaveFilePicker``). This prompts a native OS save dialog allowing you to choose your destination directory and custom filename directly before writing the file.

2. Fallback Modal Window & Standard Download

On browsers where the File System Access API is restricted, an integrated export modal window opens automatically. You can enter a custom filename in the input field (default: `SmartCut_Studio_Pro.png`) and click **Download**. The rendered full-resolution image is then saved directly into your operating system's default Downloads folder.

8. Beginner Tips, Troubleshooting & Keyboard Shortcuts

Recommended Workflow Best Practices

1. **High-contrast original images yield optimal results:** Clear distinction between subject edges and background speeds up automated segmentation.
2. **Rough green outlines are better in Step 2:** When drawing positive lassos, leave a slight cushion around your

subject. Let the algorithm detect the exact edges.

3. **Use Border Shift for colored background fringes:** If your subject was photographed against a bright red/green backdrop, set Border Shift to -2 px or -3 px to strip away residual color halos.
4. **Apply subtle background blur for realism:** In Step 4, adding 2 px to 5 px of Gaussian blur to your background layer creates a natural depth-of-field effect that isolates the subject.

Troubleshooting Frequently Asked Questions

- **Why does the status show "OpenCV.js is loading..."?**

The WebAssembly module loads asynchronously upon startup. On slower connections, this may take a few seconds. Wait until the status badge turns green (*OpenCV.js ready*).

- **Why are holes appearing inside my subject?**

If your subject contains interior colors matching the original background, increase the *Inner Protection Zone* slider in Step 2 to 10% or 15%.

- **Can I process pre-cropped PNGs with existing transparency?**

Yes! SmartCut Studio Pro automatically detects pre-existing PNG alpha channels and enables bypass mode to preserve original transparency.

Comprehensive Keyboard & Mouse Shortcuts Reference

Shortcut / Action	Scope / Step	Function Description
Spacebar + Left Click Drag	Steps 2 & 3	Pan and move the viewport canvas smoothly in any direction.
Mouse Wheel Scroll	Steps 2 & 3	Zoom in or out focused directly on your current cursor position.
Right-Click	Step 3	Cycle interactively between Restore (Add), Erase (Remove), and Pan modes.
Ctrl + Z / Cmd + Z	Step 3	Undo the last manual refinement brush stroke (up to 20 steps).
Double-Click	Steps 2 & 3	Finish and close the active Polygon (Point-to-Point) drawing chain.
Mouse Wheel Scroll	Step 4	Scales the size of the active layer (Subject or Background).
Left Click + Drag	Step 4	Reposition subject or background layer directly across the canvas.

9. Third-Party Libraries & Licensing

SmartCut Studio Pro is built upon robust open-source libraries and computer vision WebAssembly technologies. Below is a comprehensive specification of integrated third-party software components, their respective license agreements, and direct links to official repositories.

Library / Component	License Type	Usage / Purpose in App	Links & Terms
OpenCV.js (v4.10.0 Release 1)	Apache License 2.0	WebAssembly computer vision library for GrabCut segmentation, matrix transformations, morphologic filtering, and Gaussian blur.	opencv.org https://github.com/opencv/opencv
Tailwind CSS	MIT License	Utility-first CSS framework for responsive application styling, dark-mode design, and layout management.	tailwindcss.com https://github.com/tailwindlabs/tailwindcss
FontAwesome Icons (v6.4.0)	CC BY 4.0 / SIL OFL 1.1 / MIT	Vector iconography for UI controls, toolbars, modal windows, and step indicators.	fontawesome.com https://github.com/FortAwesome/Font-Awesome
Google Fonts (Inter)	SIL Open Font License 1.1	Clean, modern sans-serif typography across all interface elements and manual text.	Google Fonts Inter https://scripts.sil.org/OFL
Guided Filter Algorithm	MIT License	Fast edge-preserving guided matting filter for high-resolution edge extraction.	MIT License https://github.com/kaityo256/guided_filter
File System Access API	W3C Web Standard	Native browser standard (`showSaveFilePicker`) for saving files directly to local directories.	W3C Recommendation https://www.w3.org/TR/file-system-access/

License Compliance & Terms Summary

- **Apache License 2.0 (OpenCV):** OpenCV is licensed under the Apache License, Version 2.0. You may obtain a copy of the License at <http://www.apache.org/licenses/LICENSE-2.0>.
- **MIT License & SIL Open Font License:** Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files, to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software.