

Documentation: Improved Background Blur Tool (Web-Based)

Introduction

This project is a **web application** that enables users to apply a high-quality background blur to their photos, leveraging machine learning for precise person segmentation and soft, natural edge blending. The solution uses **TensorFlow.js** and **BodyPix** for real-time segmentation, allowing nuanced control over blur strength, mask feathering, and segmentation threshold.

Developed in modern HTML, CSS, and JavaScript, this tool is ideally suited for students, researchers, or creative professionals seeking an accessible, portable solution for image enhancement.

Features

- **Background Blur:** Blurs the image background while preserving the clarity of the foreground subject (person).
- **Soft Edge Blending:** Adjustable mask feathering yields smooth, natural transitions between subject and background.
- **Real-Time Controls:**
 - Blur Strength (5-50px)
 - Edge Feather (5-40px)
 - Segmentation Threshold (0.1-0.9)
- **Direct Comparison:** View original and processed images side-by-side.
- **Downloadable Output:** Processed images can be downloaded in high-quality JPEG format.
- **Fully Client-Side:** No data uploaded to servers; efficient and privacy-conscious.

Implementation Overview

Architecture:

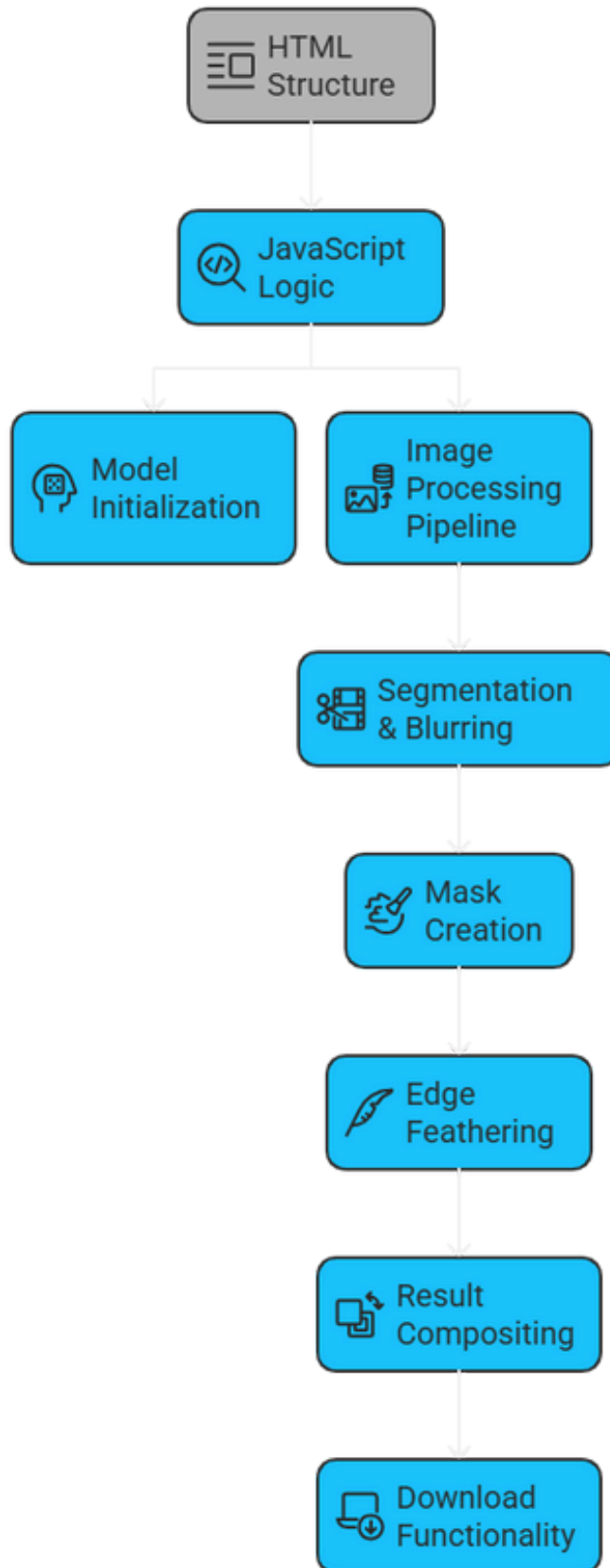
- **Frontend:** HTML/CSS for structure and styling.
- **Interactivity:** JavaScript for UI event handling and image processing.
- **ML Model:** TensorFlow.js with BodyPix, running entirely in-browser.

Key Components

- **Image Upload:** Accepts standard image formats for processing.
- **Model Loading:** Loads the BodyPix ML model using specified parameters for balance of speed and accuracy.
- **Segmentation & Masking:**

- Segments the person from the background using soft, threshold-based segmentation.
- Applies user-controlled edge feathering for realistic mask transitions.
- **Background Blurring:**
 - Blurs the background independently.
- **Compositing:**
 - Overlays the segmented subject (with softened edges) back onto the blurred background.

Image Processing Pipeline



How It Works: Step by Step

1. **Upload Image**
 - Select the image you want to process. Supported formats include JPEG and PNG.
2. **Set Processing Parameters**
 - Adjust sliders for:
 - Blur Strength: Controls the intensity of background blur.
 - Edge Feather: Smooths the mask's boundary for more natural blending.
 - Segmentation Threshold: Fine-tunes the model's accuracy for detecting the foreground.
3. **Process Image**
 - Click "Process Image" to run the segmentation and compositing pipeline.
4. **View and Compare**
 - The original and processed images are displayed side-by-side for easy comparison.
5. **Download Result**
 - Download the processed image with a single click.

Code Walkthrough

1. HTML Structure

- **Container:** Organizes the upload, controls, process button, and results area.
- **Sliders:** Allow real-time adjustment of blur, feather, and threshold parameters.
- **Comparison Area:** Displays original and processed images for immediate feedback.

2. JavaScript Logic

- **Model Initialization:** Loads BodyPix with MobileNetV1 for efficient, fast segmentation.
- **Image Processing Pipeline:** Handles file uploads, canvas operations, and user controls.
- **Segmentation & Blurring:** Utilizes BodyPix for segmentation and canvas filtering for blur.
- **Mask Creation:** Generates a soft mask using probability scores for smooth alpha blending.
- **Edge Feathering:** Applies canvas blur to the mask for seamless subject integration with the background.
- **Result Compositing:** Overlays the foreground onto the blurred background using canvas compositing modes.
- **Download Functionality:** Exports the result as a JPEG file for easy sharing.

3. Core Functions

- `loadModel():` Loads the ML model.
- `loadImage(file):` Creates an `Image` element from the uploaded file.
- `blurImage(image, amount):` Applies a blur filter using canvas.
- `maskToSoftImageData(segmentation, width, height):` Converts segmentation data to a soft mask for blending.
- Slider events update UI labels in real-time for an intuitive experience.

Customization and Extensions

To expand this project for **master's-level research or development**, consider:

- Integrating support for other segmentation models (e.g., MediaPipe, U^2-Net).
- Enabling batch processing of multiple images.
- Adding foreground enhancement (sharpness, color pop) alongside background blur.
- Allowing mask editing/refinement via drawing tools.
- Deploying as a Progressive Web App for offline access.

Usage and Best Practices

- **Optimal Images:** Best results with clearly visible subjects and uncluttered backgrounds.
- **Tuning Parameters:** Experiment with blur and feather settings for natural results.
- **Privacy:** All processing occurs in-browser, ensuring user confidentiality.

Example Screenshot

Processed images show clearer subject isolation and smoother edge blending versus naive blurring.

References

- [TensorFlow.js](#)
- [BodyPix Model Documentation](#)

Conclusion

This project demonstrates advanced web-based image processing by combining open-source ML models, interactive UI, and efficient client-side computation. **Ideal for research, prototyping, or personal creative projects at a master's level**, it showcases modern techniques in computational imaging and human-centered design.