# Vintage VR: A Method of Processing 19th Century Stereoviews for Display on 21st Century VR Systems

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**Figure 1:** *Traditional Victorian Stereoscope compared with our VR presentation of stereo view cards*

## Abstract

Hundreds of thousands of stereoscopic view cards (stereoviews) produced in the late 1800s and early 1900s are being digitized in collections and museums worldwide. However, viewing this important part of media technology history requires dedicated stereoscopes or difficult eye exercises. With the recent spread of Consumer VR, a fresh way to view, study, and learn from this vast store of knowledge becomes available. In this project, we present an automated method to process digitized stereoviews and make them suitable for VR viewing.

**Keywords:** virtual reality, stereoscopic, image processing, edge detection

**Concepts:** •**Computing methodologies** → **Image processing; Virtual reality;** *Image segmentation;* Mixed / augmented reality; •**Applied computing** → *Digital libraries and archives;* Hypertext / hypermedia creation;

## 1 Introduction

Commercially available, mass-produced stereoscopic view cards (stereoviews) were popular from the early 1850s to the late 1930s and can be considered the first populist mass-media [Waldsmith 1991]. Current techniques for viewing this large repository of cultural history are limited to special viewing techniques (similar to the cross eyed viewing of "Magic Eye" pictures), specially designed single purpose 3D glasses (primarily prismatic or anaglyph), or wiggle-grams (rapid display of left and right images to give the impression of depth and motion).

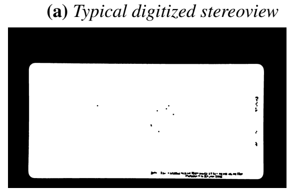
Modern VR systems are making their way into the hands of consumers, and it would be convenient to use this emerging platform to view vintage stereoviews. As most library systems are designed for flat viewing, work is required to process and format images sold over a century ago for consumption in VR. This work is focused on isolating the original left-right pair from digitized stereoviews and presenting them in a VR framework seen in Figure 1. For an interactive version, please visit https://askatom.net/vvr

## 2 Methods

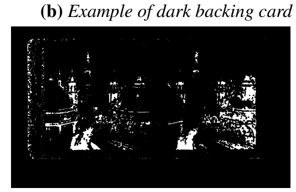
The stereo view cards (stereoviews) used in this project are from the Robert N. Dennis Collection of Stereoscopic Views at the New York Public Library. They are representative examples of turn of the century production, and largely consist of a pair of albumen prints glued onto a backing card. The digitized copies were captured against a dark background with a contrast reference card. Stereoview companies used a wide variety of styles and colors of background cards, necessitating a multi-stage approach for extracting the original left and right pair.

**(a)** *Typical digitized stereoview*

**(b)** *Example of dark backing card*



**(c)** *Card isolated based on chrominance channels*



**(d)** *The extrema light pixels in the binary identify card edges*

**Figure 2:** *Isolating the stereocard from background material and contrast reference card. Images from the New York Public Library*

### 2.1 Isolating the Original Stereoview Card

First, the original card was isolated from the background on which it was digitized. To capitalize on the chromatic difference between the stereocard itself and the dark background (as seen in Figure 2a),

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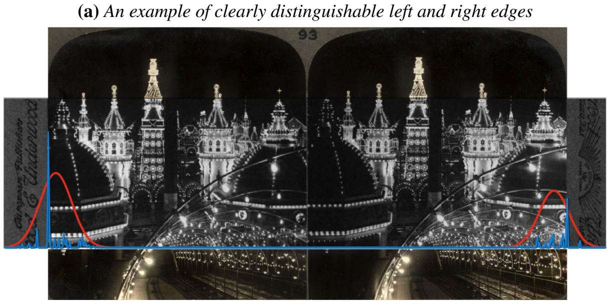
the images were first transformed from RGB to YCbCr color space. This technique works well, even for dark images with neutral backgrounds as in Figure 2b. Even the slight amount of pigmentation in the card is enough to identify the extent of the card after binarization and erosion. The non-zero boundary pixel locations were used to crop the card from the background elements.

### 2.2 Determining boundaries of embedded stereo pair

Next, an algorithm to automatically isolate the left-right pair core of the stereoviews was developed. The left-right pair was treated as a single unit, because the division between left and right images is necessarily centrally located and the pair can safely be split in half once isolated.

Again, to take advantage of the difference in color between the backing card and pasted albumen, chrominance channels were used for further processing. Each column of pixels was summed, and then the first derivative was taken to identify the greatest brightness value changes over the width of the image. This curve was smoothed, and the peaks were identified (see Figure 3). To reduce outlier peaks caused by decorations and text on the card, a biasing factor was determined. A set of 1300 stereoviews were scaled to a 1000 pixels wide, and their column differential sums averaged. This was then combined with the peak data to identify the most likely right and left edges of the left-right pair. Similar process was used to identify top and bottom edges.

**(a)** *An example of clearly distinguishable left and right edges*



**(b)** *An example of significant noise reduced by the biasing peak, leaving clear edge peaks*

**Figure 3:** *The plots used to identify left and right edges of the image pair graphed along with biasing peaks on top of the images from which they are calculated. The resultant cropped pair is shown behind for reference.*

### 2.3 Processing for VR

WebVR was identified as a target platform so the resultant images could be viewed on the widest array of VR systems possible. The MozVR A-Frame framework was chosen to quickly build a virtual museum to display the stereoviews [Krill 2016]. This enables users to interact with the gallery from any web browser in addition to the full VR experience possible with any capable VR device.

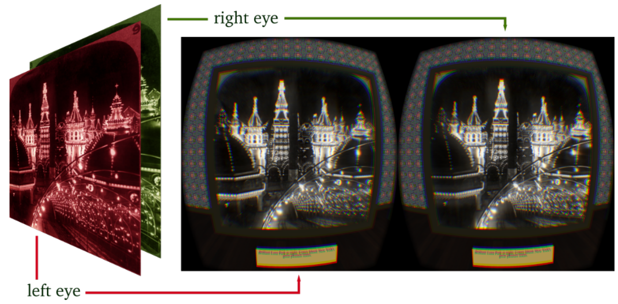



**Figure 4:** *The left and right images are stacked inside a virtual frame and displayed only to the correct eye*

When a user taps on the "Enter VR" button, A-Frame generates a WebGL camera for each eye, displaying the appropriate scene geometry on a stereoscopic display. The left-right pair is split and displayed on coincident geometry, with each half tagged to be picked up only by the left or right camera (see Figure 4). When navigating the VR scene, the stereoviews are finally viewable in their original 3D format, creating an experience much like looking out a window into the past.

## 3 Results

Preliminary data indicates our method is significantly more effective than cropping the streoviews based solely on the averaged edge location data. A set of 572 images was processed using two methods: our method and a method based on the calculated average position of a stereocard. These images were then displayed as red/cyan anaglyphs to be manually viewed and ranked. A Stereo Pair was considered "viewable" if full steroscpic effect was aparent with minimum eye strain. A summary of the results is shown in Table 1.

**Table 1:** *A preliminary survey indicates our method is significantly more successful at generating an easily viewable stereo image than cropping based on the average location of the left-right pair.*

| | Average Edges | Our Method |
|---|---|---|
| Cards Processed | 572 | 572 |
| Viewable Stereo Pair | 323 | 535 |
| Percent Successful | 56.5% | 93.5% |

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