

RESILIENCE IN COLOR: SONIC PORTRAYALS OF WOMEN'S RESISTANCE

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ABSTRACT

Resilience in Color: Sonic Portrayals of Women's Resistance is an artistic research project that explores the potential of sonification to amplify social activism. It focuses on women resisting political oppression in five countries: Turkey, Egypt, Argentina, the United States, and India. The project takes powerful viral images of these women and translates them into an immersive experience. Through a combination of auditory icons and parameter mapping, it introduces new perspectives on these stories of resilience. In this paper, I discuss the acts of resistance that inspired this work. I then detail the technical implementation of the sonification, looking at the image scanning and data mapping techniques that I adopted.

1. INTRODUCTION

Global sociopolitical movements have seen women showcasing extraordinary resilience and courage against police brutality, dictatorships, censorship, and human-rights violations. *Resilience in Color: Sonic Portrayals of Women's Resistance* leverages the concept of RGB color distance to re-contextualize these images into the auditory domain, offering a new method of engagement. This project aims to amplify women's defiance against political repression, translating their visual resistance into an audiovisual demonstration.

This paper begins by reviewing existing applications of sonification within activist art. I then discuss the technical implementation of the project, including the software used and the creative process of transforming visuals into sonification-inspired musical compositions. Following this, I articulate the goals and artistic choices in this project, exploring the motivations behind the sound design and the desired aesthetic impact. Finally, I offer a realization of the project, outlining the technical requirements and the resulting methods of implementation.

2. RELATED WORK

The potential of artistic sonification to create impactful experiences has long been recognized by artists and researchers. In recent years, sonification has emerged as a compelling tool for social commentary and raising awareness of critical issues. These projects leverage the unique capabilities of sound to engage audiences on an emotional level and inspire action. One common

theme within activist sonification involves translating environmental data into sound. Projects like *Anthropocene in C Major* [1] and *Unnatural Nature* [2] transform complex climate data into sonic experiences and cultivate an understanding of the environmental threats we face. Furthermore, sonification can bridge the gap between artistic expression and scientific data, as exemplified by *Flood Tide* [3]. This project explores the potential of sonifying real-time tidal data into a live musical performance, highlighting an intersection between artistic expression and environmental awareness.

Similar to Resilience in Color, *Hear Her Fear* [4] uses sonification to address the critical issue of violence against women. The project employs sound parameters like frequency, amplitude, and timbre to represent crime rates and incorporates auditory icons such as scream textures to emphasize the human cost of this violence.

3. IMPLEMENTATION

In this section, I detail the process of analyzing colors within the chosen images and how this informed the implementation of the work.

3.1. Analyzing Colors in Images

The color-based pixel analysis is implemented using the multimedia programming platform Processing¹. The goal is to systematically scan each image and identify which pixels match a pre-selected target color. I use Euclidean distance to calculate the difference between two colors in the RGB color space. Each color is represented as a point in three-dimensional space, with the coordinates corresponding to the intensities of the red, green, and blue channels. The Euclidean distance between two colors measures the separation between these points, reflecting the perceived difference between the colors. A smaller distance indicates a closer match to the target color. If this distance is less than or equal to the defined threshold, the pixel is counted as matching the target color.

The scanning approach is systematic and linear, moving pixel-by-pixel from left to right and from top to bottom, descending row by row until the final pixel in the bottom-right corner is analyzed. Although this method is different from the way the human eye typically scans an image, which is usually non-linear and guided by areas of interest and attention within the scene [5], it aligns with the sonification-inspired music composition framework of this project. To visually assist the audience with the scanning process, a marker glides over the image, indicating the scanner's live



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¹<https://processing.org>

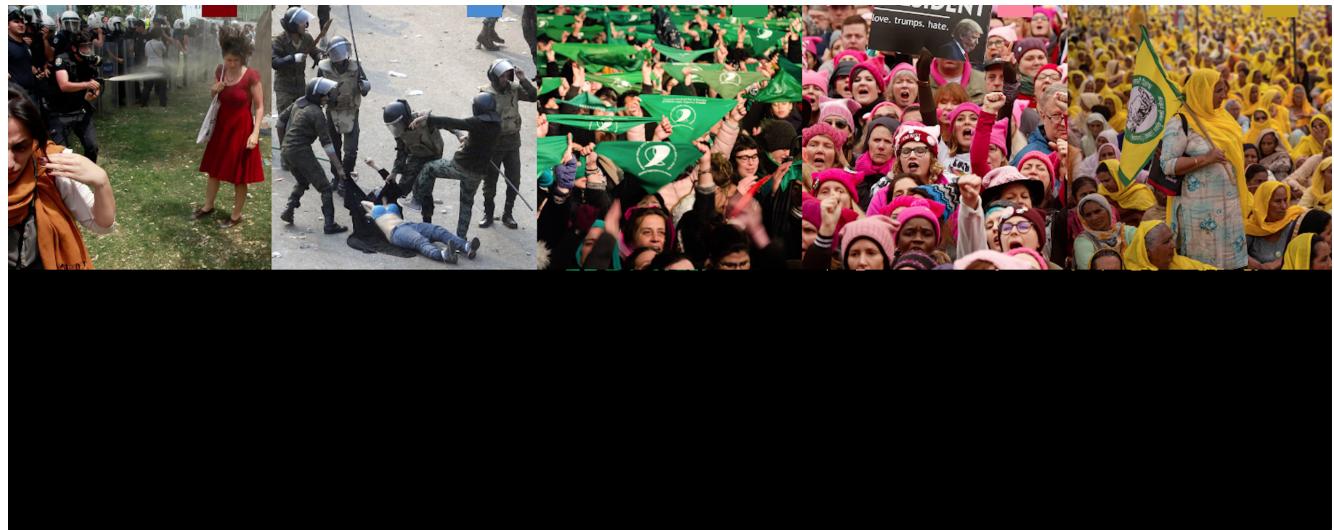


Figure 1: First Scene Screenshot. From left to right: Women in Red, The Girl In The Blue Bra, Green Scarf Movement, Pink PussyHats, Yellow Scarves

position. The color of these markers match the target color as exhibited in Fig 1. Adding a reference pointer is important for two reasons: first, to guide the audience through the imaging system's operation, and second, to provide a more natural perception of the analyzed data [6].

3.2. Visual Score

To provide further visual feedback during the scanning, a duplicative visual representation is generated beneath the original image as can be seen in Fig 2. This is accomplished by selectively drawing colored points corresponding to the pixels that meet the color criteria. Specifically, when the calculated distance between the current pixel's color and the target color falls within the threshold, a visual marker is drawn in a dedicated space. At first, these visual markers just showed me if the system was working correctly. Recognizing the inherent aesthetic and informative value of it, I decided to keep it as a feature in the work. This evolving visual score enhances the auditory experience and contributes to the project's aesthetic quality. Furthermore, the final display presents a visual summary that highlights the project's methodology as can be seen in Fig 3.

3.3. List of Images Used in The Project

This section provides details about the five images used in the project. Each image captures a moment of women actively resisting political oppression around the world. These images serve as the source material for the sonification.

- **Women in Red** (Turkey)

Photo Credit: Osman Orsal/Reuters [7]

The image, captured in Istanbul, Turkey during a moment of violence at the 2013 Gezi Park protests, shows a woman in a red dress protesting as a masked policeman discharges tear gas directly at her.

- **The Girl In The Blue Bra** (Egypt)

Photo Credit: Reuters [8]

The image, captured in Cairo's Tahrir Square in Egypt during a moment of violence in 2011, shows a woman being dragged and beaten by the Egyptian military. On the cusp of a soldier's kick, her starkly exposed torso is clad only in a bright-blue bra.

- **Green Scarf Movement (Argentina)**

Photo Credit: Brandon Bell/Getty Images [9]

The image, captured in Argentina during reproductive rights protests, shows a group of activists holding triangle-shaped green scarves above their heads as they stand in solidarity.

- **Pink PussyHats (USA)**

Photo Credit: Carolyn Cole/Los Angeles Times/TNS [10]

The image, captured in the USA during the 2018 Women's March, shows activists wearing pink beanies, also known as Pink PussyHats. The protest focused on voter registration and electing women and progressive candidates.

- **Yellow Scarves (India)**

Photo Credit: Danish Siddiqui/Reuters [11]

The image, captured in India on International Women's Day in 2021, shows women activists clad in bright yellow scarves—symbolic of mustard fields—joining mass sit-ins and hunger strikes on the outskirts of New Delhi. Their protest rallied against agricultural reforms that they feared would compromise their livelihoods.

4. IMAGE SONIFICATION AS A MUSICAL COMPOSITION

This project centers on women's resistance against political repression. To capture the spirit of vocal determination inherent in acts of resistance, formant synthesis was chosen as the foundational technique for the musical composition. Formant synthesis is well-suited for this purpose, as it allows for the creation of tones that closely resemble human voices. Through this auditory approach, the project aims to convey the persistent voices of women protesting. The resulting soundscape draws inspiration from im-



Figure 2: Mid Scene Screenshot

ages of women from different nations. Each woman is symbolically singing through sound synthesis. Their unique timbres and characteristics reflect the essence of their struggles as portrayed in the images. The resulting harmonies from these sonified voices blend to create a collective sound, a powerful sonic representation of protest and empowerment. This choir embodies unity of women resisting political oppression worldwide.

The project's sound engine is developed using Max ². Data streams from Processing to Max through OSC (Open Sound Control) communication.

4.1. Artistic Intent Behind the Sonification

As described in Section 3.2, the software generates a visual representation below the original image that provides real-time feedback as the software scans each pixel. Interestingly, the evolving visual score, with its patterns of colored points, resembles graphic notation. For example, an image from Egypt featuring a woman in a blue bra displayed a sparse distribution of pixels compared to others. Similarly, the image with a woman in red clothing had a distinct gap in the middle of the image, while the women with green scarves lacked pixels in the bottom right corner, as can be seen in Fig 3. Inspired by the visual patterns emerging from the colored markers, I used parameter mapping (e.g., color distance to amplitude) to represent this interplay between presence and absence [12]. The stark contrast between pixels exceeding the threshold (absence of color markers) and those falling below (represented by colored dots) informed the voice mixing strategy. The distance between a pixel's color and the target color directly influences the volume level of a specific voice within the five-part vocal composition. However, to ensure that the women's voices remain prominent in the sonification, a creative solution was implemented for pixels deviating from the threshold. Rather than reducing the volume of the voices further, which could symbolically weaken their presence, the distance exceeding the threshold is mapped to a sequenced kick drum sound. The kick beat serves as a symbol of persistence.

While the source images depict the struggles of women confronting political oppression, the artistic intent behind the sonifi-

cation is to celebrate their unwavering spirit and resilience. The sonification avoids any sudden sounds that might evoke a negative response and disrupt the intended *texture-carried* [13] composition. These interwoven textures create a sense of unified resistance. Furthermore, a delay effect was implemented for Women in Red and The Girl In The Blue Bra. In the source images, these women are seen as isolated figures confronting police and military brutality. The data coming from the images control each other's delay time. This strategy aims to represent a sonic representation of solidarity.

4.2. SpatIALIZATION

This project aims to sonically transport the viewer into the heart of a protest, capturing the emotional energy and collective spirit of resistance. Leveraging immersive audio formats is important to achieving this artistic vision. Protests are often charged with a multitude of emotions: anger, defiance, hope, and solidarity. Immersive audio allows the viewer to be surrounded by the composition similar to the soundscape of the protests. This heightened sense of presence can help establish a deeper emotional connection with the artwork [2].

The current system supports rendering the audio in stereo, 5.1 surround sound, and Ambisonic formats using IRCAM's Spat5 software ³. This flexibility allows for its adaptation to different presentation spaces with varying immersive audio capabilities.

4.3. Duration

Resilience in Color is adaptable in its presentation methods. It can be presented as a concert piece or an installation. The overall duration of the composition is dictated by the scanning speed of the images. With a 1-millisecond scan time per pixel, the piece runs approximately 25 minutes. The current limitation on speed is intended to keep the piece at a more traditional concert piece length.

The adjustable nature of the scanning speed allows for creating temporal dynamics between the images, potentially condensing or

²<https://cycling74.com>

³<https://forum.ircam.fr/projects/detail/spat/>



Figure 3: Final Scene Screenshot

expanding the experience from desired minutes to days. Introducing variable speeds creates interesting textures in the sound, ranging from highlighting subtle formant changes at slower speeds to generating faster transitions at higher speeds.

5. CONCLUSION

“Resilience in Color: Sonic Portrayals of Women’s Resistance” seeks to capture the emotional energy and collective spirit of resistance, contributing to the expanding field of activist sonification by using RGB color distance for data mapping. This project translates powerful images of women resisting political oppression into an immersive sonic experience. Through its adaptable presentation format and support for various immersive audio systems, the project can be installed in various spaces to engage diverse audiences. The image sonification system developed for this project can be utilized to sonify other images as well. Therefore, I aim to expand the scope of this project in the near future to utilize the sonification system for artistic installations and music performances wherein images depicting activism and resistance are centered. Further materials that document this project can be viewed at <https://zeynepozcan.github.io/resilienceincolor>.

6. REFERENCES

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