# Monochromatic Urban Patchwork: Map of Averaged Urban Ambience

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## Abstract

*Monochromatic Urban Patchwork* (MUP) (2023) presents a novel fusion of cartography and multimedia, transforming street view videos into a map of urban ambience. We analyze diverse temporal moments across the city through video, distilling audiovisual elements into representative colors. The root mean square (RMS) values from audio tracks guide the extraction of significant chromatic instances creating a palette that reflects the city's rhythm. These average RGB values, corresponding to times with peak RMS values, are geospatially mapped, representing the city in harmony with transient sound events and urban ambience. MUP embodies the real-time urban ambience, manifesting it in the mediums of imagery and video, encouraging the map reader to imagine urban narratives through the colored map. This practice of merging map-making with environmental sound analysis underscores the integration of multimedia into cartography. It effectively captures the identity of urban environments, arousing further curiosity about different districts by imagining the ambience through colors. MUP translates the nuances of the city, offering a condensed representation of spaces through the practice of cartography.

## Keywords

Urban Ambience, Speculative Design in Cartography, Geospatial Mapping, Multimedia Analysis, Audiovisual Data Integration.

## Introduction

Cartography as a discipline embodies rule-making for the mapping of the physical world into a lower-dimensional representation. This practice necessitates a series of reductions and conversions, where our complex reality is transposed into a flatter form [1, 2]. Throughout this geographical depiction, a range of intentions and semantic layers are superimposed upon the map, each reflecting the cartographer's subjective decisions about what features to include, emphasize, or omit [3]. Such an approach challenges the conventional perception of maps as mere navigational tools, repositioning them as profound acts of semantic and symbolic representation [4].

The advent of the digital era has notably augmented the epistemological aspects of cartography, particularly in capturing the intangible qualities of urban environments [5]. Within this context, the concept of 'urban ambience,' defined by its perceptible and experiential attributes, has emerged as a pivotal element in contemporary cartographic discourse [6]. Urban ambience, a term encapsulating the multifaceted



Figure 1. Video recording of urban landscape using a mobile phone, capturing the urban ambience. This image offers a neutral depiction of the perceptual differences prioritized by subjective experiences versus the digitized viewpoint recorded by the camera. ©Martin Hieslmair / Flickr (CC BY-NC-ND 2.0).

atmosphere derived from collective human experiences and interactions within specific environments, brings forth a dynamic, multi-sensory, and interactive perspective to urban studies [7].

Central to the articulation of urban ambience in cartography is the role of color. In urban landscapes, characterized by a juxtaposition of static and dynamic components, color emerges as an essential tool for interpretation and perception [8]. It shapes not only immediate perceptions but also embeds itself in long-term memories, carrying specific meanings influenced by societal norms, cultural contexts, and personal experiences [9, 10]. The psychological impact of color in cartography, long recognized for enhancing map readability and comprehension, now extends to convey the qualitative aspects of urban environments, such as mood and ambience [11].

The concept of cognitive mapping [12] provides a foundational understanding of how individuals perceive and navigate urban environments. This framework emphasizes the importance of elements such as paths, edges, districts, nodes, and landmarks in shaping the mental maps of city dwellers. Building on this, our practice explores how color can be extracted from street view videos, suggesting a multimedia analysis approach to making these cognitive maps.

In *Monochromatic Urban Patchwork* (MUP) (2023), we discuss the essence of cartography and its implications on quantized impressions of the polychromatic world. MUP reassembles the local cartography using a single color for each spatiotemporal moment. When recording street videos across various districts in the city of Linz, Austria (Figure 1), the smartphone's screen functions as a portal to a world seemingly paused in motion with its fixed perspective, later processed to a monochromatic representation of a scene that, beyond its confines, is bursting with color and life. The act of recording with a digital device captures the authenticity of our chromatic experiences, and through our data-driven approach, we explore how much it creates a sanitized, less nuanced version of reality [13]. The recorded cityscape thus becomes a fulcrum for questioning the discrepancy between the rich tapestry of the physical world, as experienced through individual attention and the evolving impressions of memory, versus the digitally mediated landscapes that are often devoid of this subjective chromatic depth [14].

MUP reimagines cartography in the digital age, focusing particularly on urban landscapes and cities. By projecting computational results of urban ambience onto maps, we emphasize the pivotal role of color in representing and interpreting urban life. MUP seeks to redefine the concept of cartography, elevating it from a tool of orientation to an artistic medium that embodies the urban ambience [15]. Our work aims to embrace the subjective and experiential aspects of urban landscapes. MUP aligns with efforts to make urban maps as instruments for understanding the shared atmosphere within the city.

## Related Works

Recent developments in cartographic studies signify an epistemological shift, accentuating the influence of technological advancements and societal dynamics in redefining contemporary cartographic methodologies [16]. This transformation is further advanced by adopting a processual and practice-oriented lens, which posits maps as dynamic, contextually embedded entities, deeply influenced by their socio-cultural environments [17]. This perspective challenges the traditional conceptualization of maps, positioning them as outcomes of complex human practices and societal discourse. Moreover, maps are seen as both influencers and products of societal norms and conventions, thereby playing an instrumental role in elucidating and shaping human and societal interactions [18].

Kraff et al. [19] delve into the nuances of human perception and its impact on the interpretation of complex urban environments, specifically focusing on the interpretation of colors in high-resolution satellite imagery. It highlights the intricate and diverse color palettes present in urban landscapes, especially in densely populated areas like slums. The study highlights the variability in individual perception of color and texture, demonstrating how different interpreters can produce varied interpretations from the same satellite imagery. This subjective nature of color interpretation in

satellite images underscores its broader implications for remote sensing, suggesting the need for more sophisticated methods to address these perceptual variations. Furthermore, the integration of digital technology in urban spaces explored by Kjeldskov et al. [20] introduces a novel dimension to the urban ambience, merging the physical and digital realms.

Considering the concept of 'acoustic ecology' [21] provides critical insights into the auditory dimension of urban ambience. Raimbault et al. highlight the evolution of urban
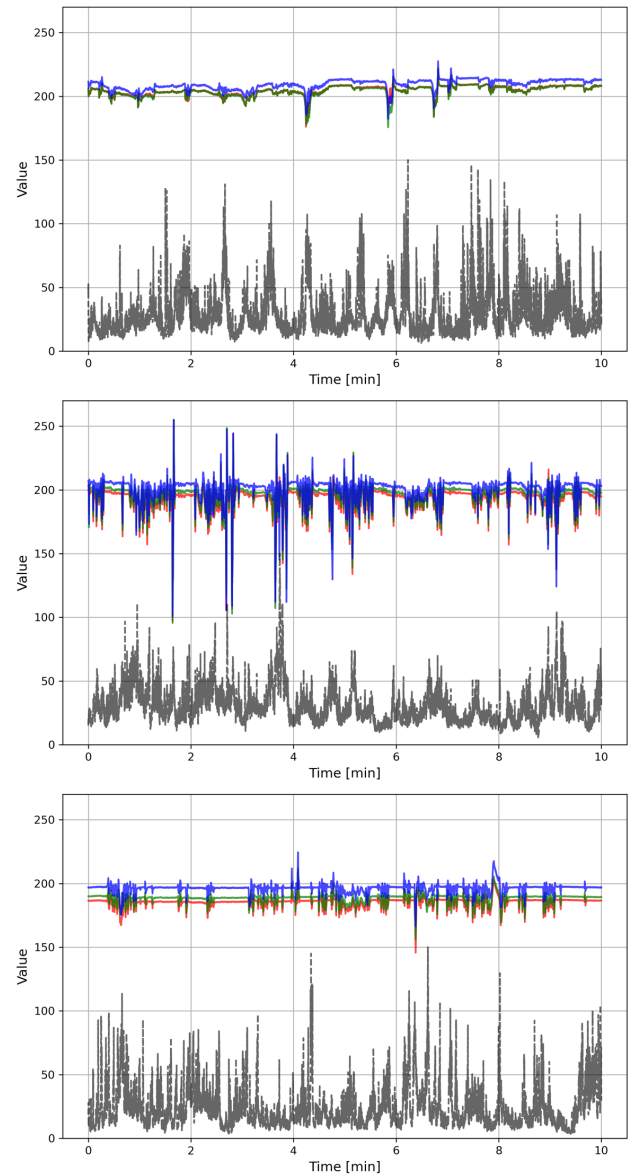


Figure 2. Temporal analysis of RGB channels and RMS values. Comparative analysis of RGB channels and RMS values, scaled from 0 to 255, from videos recordings at Hauptplatz Linz, taken at 11 AM on 9 October 2023. The graph's x-axis represents time in minutes, while the y-axis displays the scaled RGB and RMS values. Each line traces the district-wise aggregate of these values over time.

noise from being perceived merely as pollution to being understood as a part of soundscape [22]. Their work delves into how city users perceive and categorize sounds, with these perceptions influenced by semantic values and multimodal experiences. This underscores the need for an integrated approach that goes beyond mere noise reduction to enhance sound quality and incorporate the cultural context of sound. Complementing this perspective, Offenhuber et al. examine the relationship between urban morphology and soundscapes [23]. They critique the historical tendency in urban planning to prioritize visual aspects, often neglecting sonic qualities. Their investigation reveals how urban morphological measures can be adapted to understand acoustic qualities in urban environments and demonstrates the profound impact of the built environment on soundscapes. The authors also discuss the cognitive and observational dimensions of soundscapes, emphasizing how sonic environments can significantly shape the memory and experience of urban spaces, sometimes more significantly than visual stimuli.

Our objective in MUP was to capture the essence of urban ambiance through daily narratives, offering a nuanced portrayal of cities via video and audio analysis. This method enriches our cartographic representations, showcasing how sensory and experiential factors interplay within urban spaces, both within and beyond our immediate attention, and across different scales. In alignment with the concept of media as extensions of the body [24], our project emphasizes the use of mobile phones as vital instruments in contemporary life. These devices act as digital extensions of the human sensorium, effectively documenting individual perspectives and sharing personal spatial experiences. We aim to craft an embrace cartography that encapsulates not only the visual but also the aural essence of cities. By integrating colors that represent urban ambiance, a result of our devised algorithmic approach, our work illustrates the evolving nature of cartography. Our approach to cartography, executed through the lens of mobile phones, embodies a daily practice of personal exploration and temporality [25]. This method transforms each individual's journey into an act of creating cartographic art, situating it within the contemporary context of spatial environments [26].

## Data Processing

In our effort to capture urban landscapes and their corresponding events, we conducted a series of recordings in Linz. This involved capturing thirty 10-minute videos across five different districts, with three unique spots in each district. Each spot was recorded twice, once in the morning and once in the afternoon. As a result, our video dataset has evolved into a diverse collection, allowing us to compare temporal differences effectively. After recording the urban landscape, we observed the dynamic interplay of visual and auditory elements within urban environments through a time-series analysis (Figure 2). The plots demonstrate how

the red, green, and blue channel values vary over time, normalized between 0 and 255 for each video recording. These plots represent different chromatic trends of each street view video. Additionally, the dashed black line in each subplot indicates the rescaled RMS values, a reflection of the audio amplitude variations. This comprehensive analysis helps in understanding the variations in both color and sound dynamics across various urban settings in Linz.

Figure 3 serves as a multifaceted data representation, showcasing an integrated audio-visual analysis derived from a high-definition video. The first column comprises line plots, each charting the root mean square (RMS) values of the audio track across the video's duration. These graphs are punctuated by red vertical lines, which signify the instances of greatest variance in accumulated RMS values within a discrete window of 30 frames, which is a single second for 30fps video, a methodological choice designed to pinpoint significant auditory events. Aligned with these auditory markers, the second column provides a visual context by displaying the exact video frames that correspond to the moments of peak change in the audio track. These frames offer a glimpse into the visual narrative concurrent with the identified auditory fluctuations. The third column distills the visual complexity of the frames into singular color patches, each annotated with a hexadecimal code. These patches are not randomly selected hues but are calculated as the mean-averaged color values for the entirety of pixels within each highlighted frame, thus providing a visual summary that is both precise and indicative of the frame's overall colorimetry.

Such multimedia data analysis exemplifies a novel approach where the intersection of sound and image is quantified and presented in a manner that allows for immediate



Figure 3. Composite analysis of audio-visual data extracted from a 10-minute HD video. The left column displays line plots of RMS audio values, with a red line marking the point of maximal change within a 30-frame window. The central column captures the corresponding video frames at these points, while the right column features the color patches with their respective hexadecimal codes, representing the mean-averaged color value from each identified video frame.

visual and analytical interpretation. The resulting RGB values can be mapped with their coordinates as a collage of patches (Figure 4). These nine squares, rendered in shades and sizes as varied as the moments captured in the video, are emblematic of a collective memory, a shared urban narrative rendered through the lens of computational objectivity. Each shade, a mean-averaged RGB value derived from a video frame, is a democratic summation of the city's chromatic pulse at a given instant.
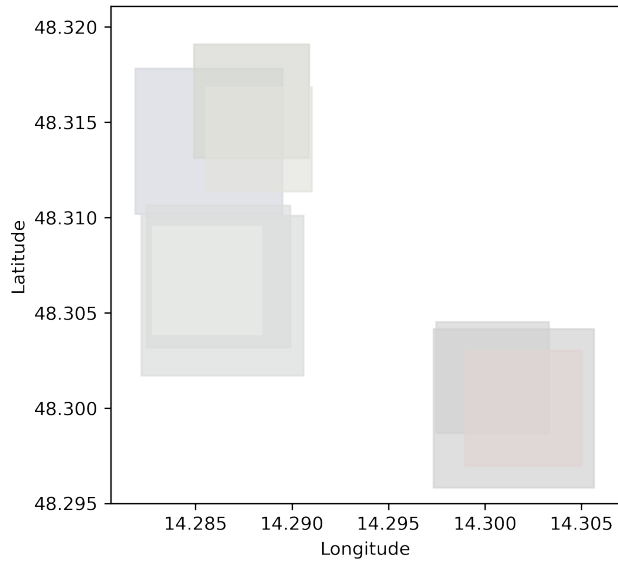


Figure 4. Geospatial mapping of averaged urban ambience.

## Monochromatic Urban Patchwork (MUP)

MUP offers a unique foundation for discussing the essence of cartography and its implications on our understanding of the world (Figure 5). MUP unfolds as a compelling interrogation into the very fabric of urban topography. Drawing from a wellspring of audiovisual data, this piece distills the ephemeral cadence of city life into a series of definitive temporal snapshots. Each chosen moment undergoes a meticulous extraction process, yielding colors that speak for the disparate districts within the city's embrace. These hues, though perhaps disparate from the visceral urban tapestry we navigate daily, emerge as computed truths, representing digitally abstracted essences that capture the rhythm and pulse of the city. This representation acknowledges the inherent tension between the collective and the individual within the urban landscape. While the computational process may homogenize the vibrancy of personal recollections into a singular color metric. These color patches, then, are not merely a reductionist view of the city but a space where the multiplicity of perspectives is distilled into a universal language of color.



Figure 5. *Monochromatic Urban Patchwork* (MUP) series, mixed media, variable size, 2023. The processed RGB values are dynamically modulated to mirror the city's auditory energy. Utilizing RMS value as a proxy for vibrancy of the city, color values pulsate with the environmental sound's acoustic property, enhancing intensity to reflect the city's acoustic fluctuations. Concurrently, a color shift mechanism recalibrates the dominant hues, modulating saturation in direct proportion to the RMS levels, embodying the soundscape's influence on the visual domain. ©Youngjun Choi

As an averaged result of each mobile device, all hued patches are a node in the network of collective urban experience. MUP as urban palettes renders a city that is at once familiar and colored new. This reimagined topographical landscape presents a study in contrasts, juxtaposing the calculated precision of technology with the organic warmth inherent in the urban fabric.

The inspiration for MUP lies in its transformative vision: a dynamic cartography that evolves in real-time, reflecting the living, breathing entity that is the city. It's an ever-shifting mosaic that reflects the now, harnessing the power of the moment to redefine our visual and experiential understanding of urban spaces. Through MUP, we are invited to witness a city recontextualized, its colors reborn through the lens of digital abstraction, and its contours recharted for a new age of artistic and technological synergy.

The RMS-based chromatic averaging algorithm opens up new possibilities for how we start our curiosity in adjacent or distant areas, further inspiring the map readers to interact with, perceive, and navigate our urban surroundings. Beneath this uniform exterior lies a mosaic of individual device's activated history, distilled perceptions uncovering patterns and characteristics. The implications as an effective data visualization enabling interpretation of the enhancement of livability and aesthetic appeal of urban spaces through map. By incorporating these insights into urban

design practices, planners and designers have the opportunity to create environments that resonate more deeply with the inhabitants and visitors, fostering a sense of connection and well-being.

This cartographic practice, where every color patch represents an individual practice [27], is much like the way individual memories and digital captures contribute to the narrative of personal experience which has become a daily activity through mobile devices. By abstracting the city into this form, the work invites contemplation of how individual moments are woven into the collective fabric of the city's memory. It challenges us to consider how our singular experiences contribute to the collective identity of a place and how technology mediates our relationship with the shared spaces we inhabit. In this light, the squares become a metaphor for the public sphere itself, a place of both unity and diversity, where the individual and the collective negotiate their coexistence [28]. The colors, in their computed impartiality, offer a glimpse into the complex narrative of urban existence, where every patch is a story, and every story belongs to us all.

## Conclusion

The indexical nature of maps, where each symbol or color denotes a specific reality, also underscores the importance of semiotics in cartography, with the map becoming a coded document that communicates much more than geographical information [29]. Furthermore, the phenomenological aspect of cartography is pivotal. It engages with how individuals experience space and place, acknowledging that maps are not just representations but also creations that can affect perception and lived experience [30]. The act of mapping, then, is akin to digital capture, where the process of documenting is not passive but actively constructs a new reality that can either align with or diverge from the subjective experiences of those who navigate the physical world [31].

The comparative analysis of various urban landscapes through the lens of computed hue values has yielded profound insights into the diverse nature of urban color signatures. MUP has demonstrated that each city, with its unique blend of architecture, culture, and natural elements, manifests a distinct hue profile, which not only characterizes but also distinguishes its urban fabric. The role of color in these urban environments goes beyond mere aesthetic appeal; it serves as a nuanced reflection of each city's cultural and historical identity, offering a rich tapestry of information about how these spaces are experienced and interpreted.

In MUP, we engage with a broader discourse on the nature of perception, attention, and the transformation of experiences from the chromatic richness of reality to the potentially desaturated digital medium. Cartography, much like the digital medium, is a tool of translation that converts the rich tapestry of the world into a simplified form, imbued with layers of meaning that reflect a multitude of human intentions. The cartographer, much like the photographer, is not just a chronicler of landscapes but a creator of worlds, each with their color and character, informed by the myriad decisions that shape the final depiction. Our research demonstrates the potential and possibility inherent in 'cartographic interfaces'. The integration of multimedia in the practice of cartography for urban ambience represents a significant transcendence beyond the traditional confines of two-dimensional media.

## Acknowledgement

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