

# **Open Source City: Mobile Technology in the Public Realm**

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**Abstract**

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Mobile technology has become ubiquitous and is reshaping the city. The built environment has a key role in the success of public spaces and the richness of public interaction. However, technology works separately, from outside the built environment, fostering online interaction often at the expense of public interaction. Architecture that shapes both the modes of urban walking and the use of technology in the city can tie the two together to unify online and public interaction in the digital age. This thesis serves as a prototype for future projects that integrate architecture and technology to improve the public realm.

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## CHAPTER I

### INTRODUCTION

Mobile technology has swiftly become ubiquitous in the city. Like the automobile networks that cut through the pedestrian fabric a century ago, the “information superhighway” is reshaping cities today. The smartphones, tablets, wearable and integrated devices are transforming the built environment faster than society can adapt.

Architecture provides the framework that shapes the experience of walking in the city. The built environment has a key role in the success of public spaces and the richness of public interaction. However, technology works separately, from outside the built environment, fostering online interaction often at the expense of public interaction. Smartphones give us access to the internet from anywhere. According to the Pew Research Center, 50% of Americans, and almost two-thirds of 18-29 year olds, use their phone while walking from place to place.<sup>1</sup> Today’s mobile technology impacts the use of public space, creating a predictability that reduces the richness of the urban experience.

This transformation is evident in the city of San Francisco. As the home of established

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<sup>1</sup> Pew Research Center. “The Smartphone Difference.” April 1, 2015. <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>.



Figure 1.1: Walking in San Francisco



Figure 1.2: Text Walking Lane  
(<http://www.dailymail.co.uk/>)

information technology and internet companies as well as an abundance of startups, this city serves as a fitting testing ground for the social impact of mobile computing. A historically walkable city, San Francisco is uniquely suited for an investigation into the culture of walking as a means to reclaim increasingly privatized, technological space.

This thesis proposes that architecture needs to adapt to the technological city by rethinking the design of public space. As the physical shaper of spaces for urban walking, architecture plays a leading role in the pedestrian experience of the city. The presence, absence, and shape of buildings form edges, paths, and nodes that make the city memorable and navigable. First, this thesis will examine urban walking as a social experience through an analysis of walking as interactions with the city. Then it will examine the impact of the current portable, location-based, and individualized usage of mobile devices on the public realm.

The proposed interventions bridge gaps in the existing connected sequence of San Francisco neighborhood nodes. By leveraging the impacts of technology to induce public interaction, architecture can produce a multi-dimensional urban experience that strengthens the public good. As an investigation of the adaptability of this universal framework, this thesis examines two sites along a key path in the city. Architecture that reads its environment will better adapt to the behaviors of urban dwellers.

Architecture that shapes both the modes of urban walking and the use of technology in the city can tie the two together to unify online and public interaction in the digital age. This thesis demonstrates a new design for public space that is responsive to the ever-changing conditions of the city. The thesis serves as a prototype for future projects that integrate architecture and technology to improve the public realm.

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## CHAPTER 2

### THE EXPERIENCE OF URBAN WALKING

Walking is our most basic form of movement. Travelling on foot allows us to transport ourselves through our environment without the use of technology. Walking is slow and physical. The pedestrian senses their body, experiences the topography, and feels the weather. Through the rhythm of step after step, we perceive our surroundings as a series of connections. Walking in the city is fundamentally participatory. A hiker may attempt to minimize their impact on the natural environment, and a jogger often attempts to tune out the environment, focusing on the mechanics of their body. The urban walker not only experiences, but must physically interact with their human-made surroundings.<sup>2</sup>

In his book, *Life Between Buildings*, Jan Gehl studies the link between pedestrian flows, both stationary and moving, and public space. He introduces the categories of necessary, optional, and social activities<sup>3</sup> to characterize how people inhabit and shape the urban environment. Unlike necessary functions, which occur regardless of their surroundings, optional activities are recreational, and are strongly influenced by the environment. Social

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2 Rebecca Solnit, *Wanderlust: A History of Walking*. (New York: Viking, 2000), 174.

3 Jan Gehl, *Life between Buildings: Using Public Space*. (New York: Van Nostrand Reinhold, 1987), 9.

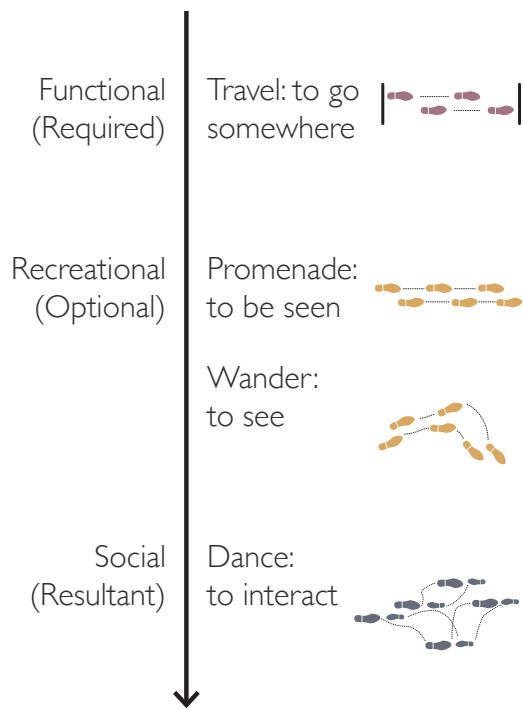


Figure 2.1: Modes of Urban Walking

activities, including all types of spontaneous, communal interactions, only happen in truly successful urban spaces.<sup>4</sup> Pedestrians can shape and be shaped by the spaces between buildings in the city. Gehl points out that walking is a simple way for us to be present in public.<sup>5</sup>

The act of walking in the city can be analyzed similarly, according to the different ways the walker moves through space. The modes of *travel*, *promenade*, *wander*, and *dance* typically occur in combination (Figure 2.2).

*Travel* can be defined as walking to get somewhere. It is practical and functional, emphasizing the direct link between the origin and the destination. While travel necessarily occurs in any environment, it will last longer in good public spaces.<sup>6</sup> The typical pedestrian will linger along interesting paths while walking faster in an unpleasant environment.

The second mode of walking is *promenade*, or walking to be seen. The promenader often chooses a wide, straight path where he or she can be easily viewed by others.

As described by Rebecca Solnit, walking “is not a way of getting anywhere, but a way of being somewhere.”<sup>7</sup> Similarly recreational is *wandering*, or walking to see and explore. The



Figure 2.2: Simultaneous Walking Modes

4 Gehl, *Life between Buildings*, 11.  
 5 Gehl, *Life between Buildings*, 133.  
 6 Gehl, *Life between Buildings*, 11.  
 7 Solnit, *Wanderlust*, 66.

wanderer will change directions while walking, choosing paths with interesting scenery, pausing at shops or other buildings, and people-watching. These two modes are optional and recreational. As Gehl argues, optional activities, like *promenade* and *wandering*, occur rarely in poor public spaces but frequently in good ones.<sup>8</sup>

The final mode is *dance*, or the interaction that occurs between the walker and the city. The urban walker is encouraged to stop and talk, to make eye contact with other pedestrians, to enter buildings in order to shop and eat. *Dance* describes the kind of spontaneous social activity that can occur in public spaces that encourage people to linger. The longer the duration of walking as *travel* and the more frequent the occurrences of *promenade* and *wander*, the more likely *dance* will occur (Figure 2.3). The quality of public space can have a major impact on the frequency and duration of planned and informal activities that occur there.<sup>9</sup>

As Jan Gehl states, the life between buildings is shaped by the physical properties of architecture. In studying the way people use space, Gehl identifies the determining factors in creating a vital street life, listing five key principles for promoting contact: no walls, short distances, low speeds, one level, and orientation toward others.<sup>10</sup> The height and density of buildings define the proportions of a public space. The detail and transparency

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8 Gehl, *Life between Buildings*, 11.

9 Gehl, *Life between Buildings*, 12.

10 Gehl, *Life between Buildings*, 72.

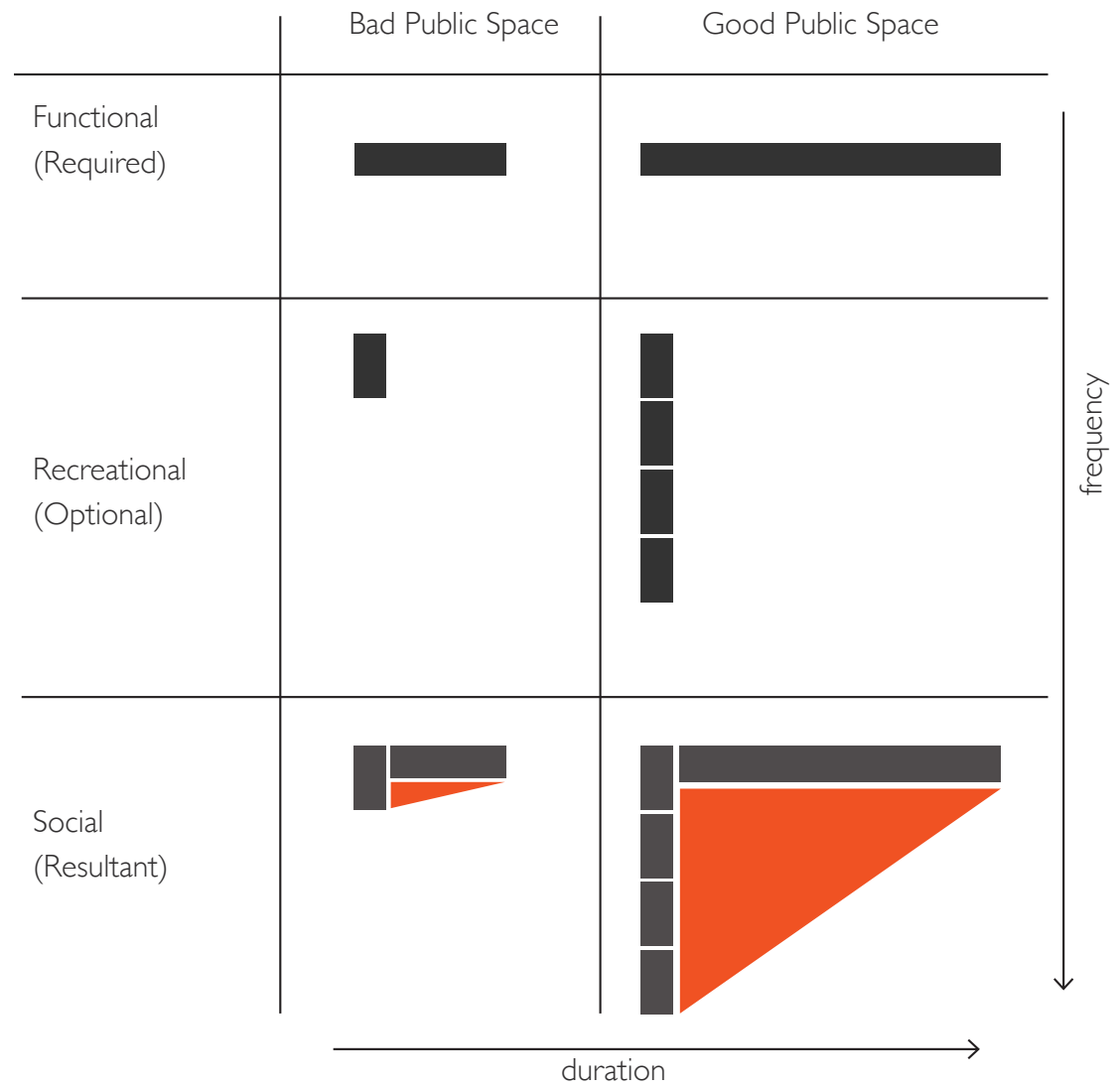


Figure 2.3: Relationship between the quality of public space and activity

of the facades, as well as the texture and width of the pedestrian zone, are also critical in encouraging people to pause in and return to a given place. In return, the activities generated by people in that location add life to the architecture and movement to the public space. Together, buildings, in-between spaces, and activity form the experience of the city.

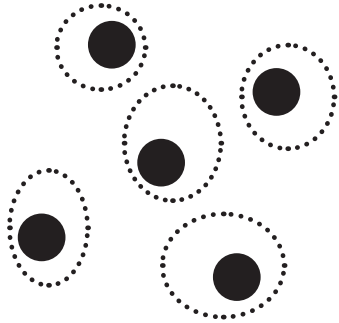


## TECHNOLOGY IN THE CITY

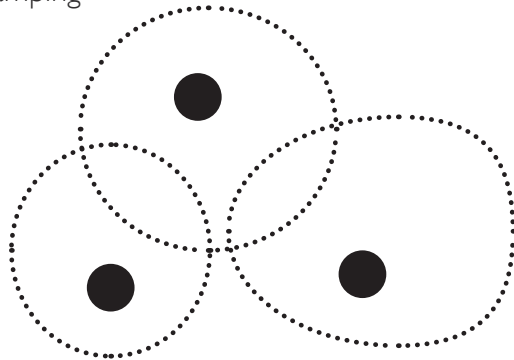
Today's city is increasingly influenced by a fourth component, technology. Mobile communication systems are now everywhere, altering existing public activities and social practices (Figure 2.4). Ito, Okabe, and Anderson argue that portable technology is privatizing urban space through three placemaking processes: cocooning, camping, and

Figure 2.4: Wandering path taken by a woman in a shopping mall whilst talking on her mobile phone (Courtesy Horst Kiechle, <https://www.flickr.com/photos/archisculpture/>)

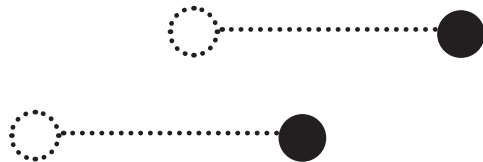
Cocooning



Camping



Footprinting



footprinting (Figure 2.5).<sup>11</sup> Through these “genres of presence” or placemaking processes, technology is reshaping the activities that occur in the spaces between buildings.

The authors first discuss *cocooning* (Figure 2.6) as the ability of portable media devices to create a “private territory within the confines of urban space”.<sup>12</sup> Listening to music on headphones allows the wearer to disconnect from the sounds of the street. Texting or browsing the web in public removes the user from the social experience of the city.<sup>13</sup> The mobile device thus creates a place that is temporarily unattached to physical locations. *Cocoons* also allow the user to pass time in or shut out places they find uninteresting.<sup>14</sup> Ito, Okabe, and Anderson argue that mobile technology *cocoons* have become ubiquitous across the modern city.

People also use portable information devices for *camping* (Figure 2.7), or to establish personal work space within public places.<sup>15</sup> This form of encampment is longer term and more place-specific than cocooning, as people choose where to spend their time based on its perceived characteristics. Camping allows the user to see and be seen, to interface with their surroundings in a limited way. A pedestrian may set up a temporary workspace

11 Ito, Okabe, and Anderson, “Portable Objects in Three Global Cities,” 67.

12 Ito, Okabe, and Anderson, “Portable Objects in Three Global Cities,” 74.

13 Mark Shepard, “Toward the Sentient City”, 24.

14 Ito, Okabe, and Anderson, “Portable Objects in Three Global Cities,” 74.

15 Ito, Okabe, and Anderson, “Portable Objects in Three Global Cities,” 76.

Figure 2.5: Mobile Technology Placemaking

in a public space to experience the presence of others, if not to interact with them.

Ito, Okabe, and Anderson defined *footprinting* (Figure 2.8) as a way of personalizing space “in the form of individualizing relationships to commercial establishments.”<sup>16</sup>

However, the recent proliferation of location-based and context-aware media begs for an expansion of this definition. Today, footprinting can be seen as both a corporate tool and a democratizing force. People can now leave customized footprints of their paths through the city. Users can annotate their urban environment by attaching bits of personal media to specific locations.<sup>17</sup> For example, Facebook check-ins and geotagged Instagrams share instantaneous memories online. Yelp and Google reviews record highly personalized information for the benefit of future visitors. By reading this data, users can tailor their experience of the city. People can visit a new place that feels instantly familiar by gleaning information from users with similar interests.

*Cocooning*, *camping*, and *footprinting* describe the ways mobile media affects spatial patterns and social behaviors in the city. The authors of “Owning the Media: New Media and Citizen Engagement in Urban Design,” similarly acknowledge that the pervasiveness of mobile technology in cities creates a “lack of space for spontaneous encounters and



Figure 2.6: Cocooning (Courtesy Kim Do-hoon)

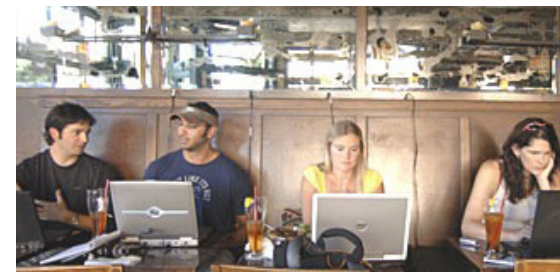


Figure 2.7: Camping ([http://usatoday30.usatoday.com/life/2006-10-04-third-space\\_x.htm](http://usatoday30.usatoday.com/life/2006-10-04-third-space_x.htm))

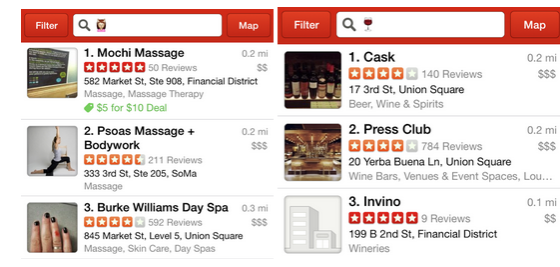


Figure 2.8: Footprinting (<https://www.yelp.com/>)

16 Ito, Okabe, and Anderson, “Portable Objects in Three Global Cities,” 78.

17 Mark Shepard, “Toward the Sentient City,” 25.

public life, and a general lack of involvement with the immediate environment.<sup>18</sup> However, de Lange and de Waal are hopeful that technology has the power to engage people in shaping their urban environments, to “act as co-creators of livable and lively cities”.<sup>19</sup> These authors identify several ways technology can empower the citizen: visualization of aggregated data made public, citizen networks formed online organized around collective issues, and urban participation through low-investment digital tools. Despite its detachment from physical place, mobile technology has had the unexpected effect of concentrating networks, skills, and knowledge in cities. In “informational cities” or “technopoles”, urban cores are flourishing,<sup>20</sup> as is evident in San Francisco.

## **MAPPING SAN FRANCISCO**

In San Francisco, people walk. According to Walksf.org, a pedestrian advocacy group, 23% of all trips in the city are made by walking.<sup>21</sup> Walkscore.com measures walkability in cities through a point system based on the distance to a variety of amenities. The system also

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18 Michiel de Lange and Martijn de Waal, “Owning the City: New Media and Citizen Engagement in Urban Design.” *First Monday* 18.11 (2013), <http://firstmonday.org/ojs/index.php/fm/article/view/4954/3786>.

19 de Lange and de Waal, “Owning the City: New Media and Citizen Engagement in Urban Design.”

20 de Lange and de Waal, “Owning the City: New Media and Citizen Engagement in Urban Design.”

21 Walk San Francisco, “Walking Facts,” accessed June 21, 2016, <http://walksf.org/learn-more/walking-facts/>

incorporates population density and block length. While San Francisco's overall walkscore is 86 out of 100,<sup>22</sup> these measurements have limits. The pedestrian experiences the city block by block, at a much finer scale than this walkability system can measure. The character and liveliness of the street also affect the pedestrian experience. As Rebecca Solnit argues, the urban environment "in its scale and its street life, keeps alive the idea of a city as a place of unmediated encounters".<sup>23</sup>

In his Geotaggers' World Atlas, Eric Fischer maps location data from photos uploaded on Flickr (Figure 2.9). Connecting the dots between photos taken by the same photographer reveals their path, reflecting the popularity of a neighborhood. A single photo indicates a moment of interest, while a sequence indicates sustained interest over distance and time.<sup>24</sup> Furthermore, color denotes the amount of time between photos; black is the slowest speed—walking. Through a graphic representation of aggregated location-based data, Fischer's maps show how footprinting is changing the way we map the city.

The Geotaggers' Atlas transforms San Francisco into a series of nodes and paths that correlate strongly with the existing neighborhood nodes. Ultimately, the map shows that

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22 "Living in San Francisco," Walkscore, accessed June 21, 2016, [https://www.walkscore.com/CA/San\\_Francisco](https://www.walkscore.com/CA/San_Francisco)

23 Solnit, *Wanderlust*, 172.

24 Eric Fischer, "Linking the Most Interesting Places in the World," *Mapbox*, April 28, 2015, <https://www.mapbox.com/blog/geotaggers-world-atlas/>



the quality of the urban environment encourages a particular kind of interaction between the walker, technology, and the city.

## THEORETICAL FRAMEWORK

Architecture has long been used to shape how we walk, and thus interact in the city. The experience of walking in the city can be categorized according to four modes: *travel*, *promenade*, *wander*, and *dance*. These pedestrian experiences often occur in combination, spontaneously adding layers of meaning to moving through the city. Architecture provides the framework that shapes this experience of walking.

Typically, design treats mobile technology as separate from this physical environment. Mobile communication devices are radically changing the use of public space through *cocooning*, *camping*, and *footprinting*. These ways of navigating the city reduce the richness of the urban experience, replacing public interaction with online interaction. At the same time, these new forms of interaction offer a hidden potential to increase overall interaction. Instead of contributing to a division between the physical and the virtual, mobile technology can be harnessed to enhance the physical world. Similarly, the city can be responsive to realtime input from the virtual world. Architecture must respond to reflect these new dimensions, leveraging technology to reclaim urban space for the public realm.

Figure 2.9: The Geotagger's World Atlas #4 (opp)  
(Courtesy Eric Fischer, <https://www.flickr.com/photos/walkingsf/>)

San Francisco is a city with a strong culture of walking that is also a testing ground for new technologies. This city is uniquely suited to investigate urban walking as a means to reclaim increasingly personalized technological space for the public realm. In San Francisco, an architecture that activates all four modes of walking can reintroduce spontaneous interaction and produce a multidimensional urban experience. A series of prototypical digital and architectural interventions along a key path in the city can activate a void in the pedestrian fabric, integrating technology and walking as tools to encourage public interaction.

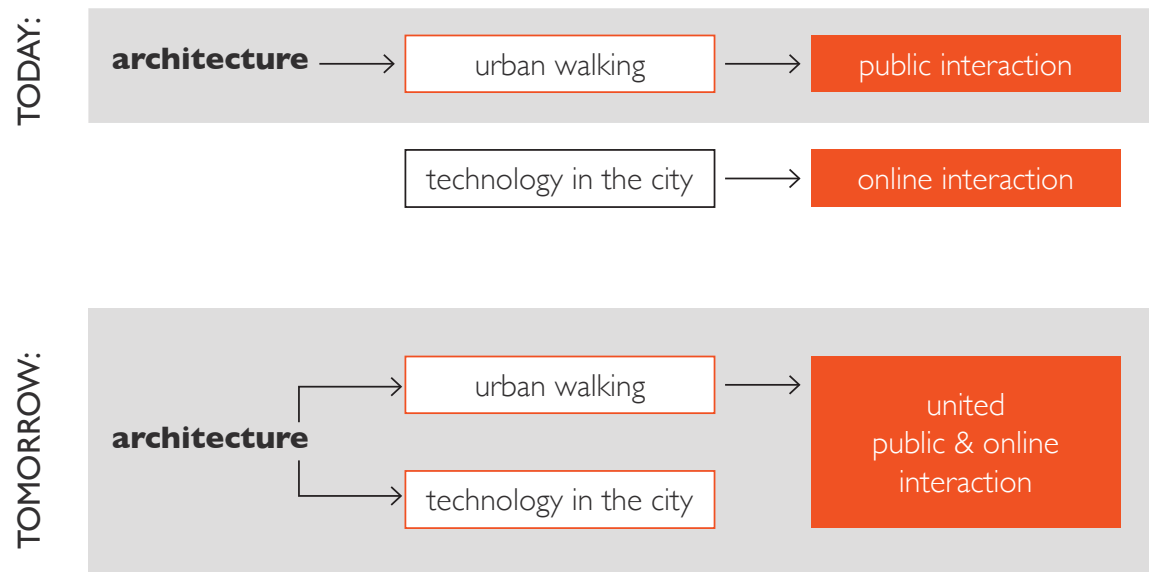


Figure 2.10: Theoretical Framework

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Figure 3.1: Islands of San Francisco  
 (<https://burritojustice.com/>)

## CHAPTER 3

### NEIGHBORHOODS & NODES OF SAN FRANCISCO

Within a city, a neighborhood forms a community and surrounds a particular place of relevance to that community. San Francisco is a city with strongly identifiable neighborhoods (Figure 3.1), and nearly all of these include at least one clear focal point, typically a park, plaza, or important intersection that is a center of transit, shopping, and public life. Energy from the node radiates along paths extending into the neighborhood.

The definition of a neighborhood is subjective and can be visualized in many ways. *The Neighborhood Project*<sup>25</sup> (Figure 3.2) by Matt Chrisholm and Ross Cohen maps the neighborhoods of San Francisco utilizing data from housing posts on Craigslist. An aggregation of posts suggests a collectively identified neighborhood, but the methodology allows for visualization of overlapping districts and fuzzy edges. *You Are Here*<sup>26</sup> is a project of the MIT Media Lab's Social Computing Group that studies place and the human experience through an atlas of city maps. A map of independent coffee shops in San Francisco (Figure 3.3) surrounds each point with a zone of color indicating the region that is walkable, within 0.7 miles, to each cafe. The map suggests that a cafe can be an

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25 The Neighborhood Project, accessed August 26, 2016, [hood.theory.org/map](http://hood.theory.org/map)

26 You Are Here, Social Computing Group, accessed August 26, 2016, <http://youarehere.cc>

organizing feature of a community, serving as social spaces, mobile offices, and people-watching destinations. The map shows a division of San Francisco's neighborhoods into zones of camping.

The Geotagger's World Atlas, like other visualizations of mobile data in Figures 3.7, 3.8, and 3.9 reveals an important east-west route taken by pedestrian photographers in San Francisco. This path passes through downtown along Market Street before veering westward and changing character to run through the Haight. Its form changes again when

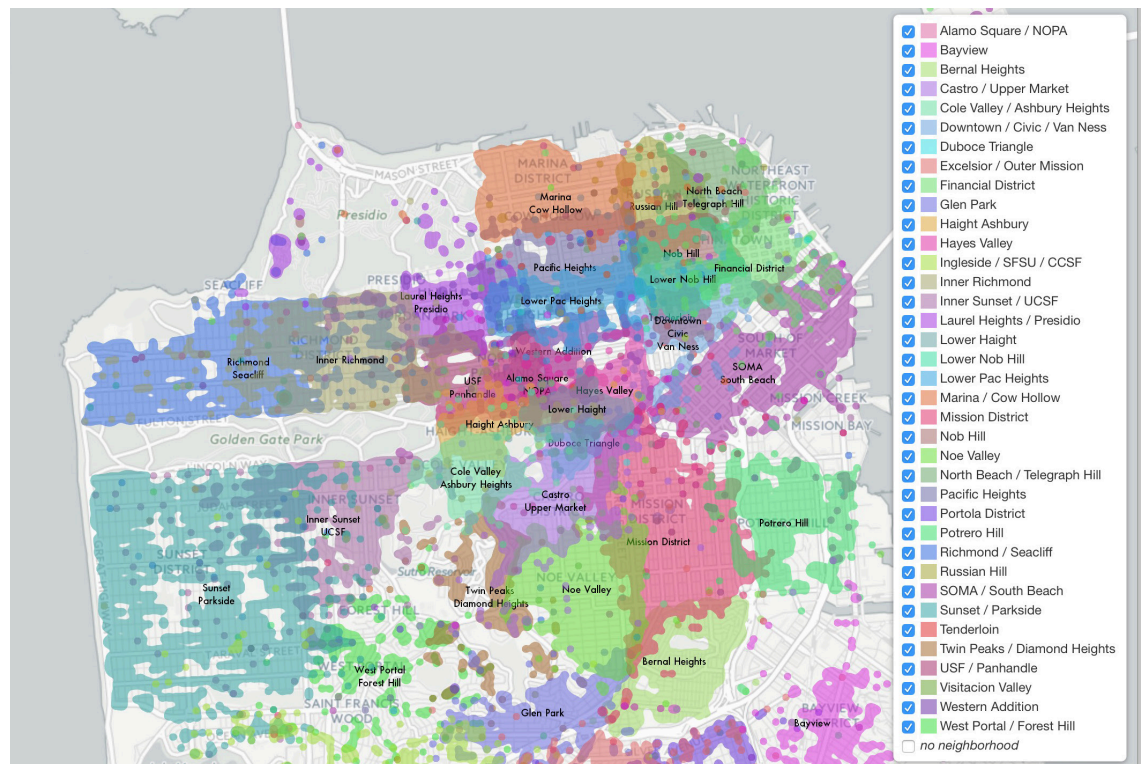


Figure 3.2: The Neighborhood Project (<https://hood.theory.org>)

it reaches Golden Gate Park, where it continues on to Ocean Beach. The path can be divided into distinct segments: downtown, neighborhood, and park (Figure 3.4). This path was studied to identify and categorize the existing neighborhood cores on and nearby the transect. I approximated the influence, measured in  $\frac{1}{4}$  mile and  $\frac{1}{2}$  mile radii (easily walkable distances for most people), on each node's surrounding context (Figure 3.5). Seen as a group, these spheres nearly cover the path, leaving only a few gaps. These holes were noted as opportunities (Figure 3.6). The "missing" links paralleled my subjective experience of walking through them.

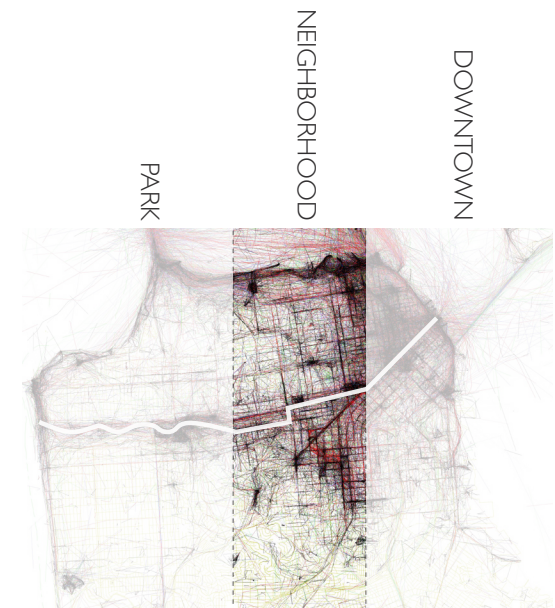
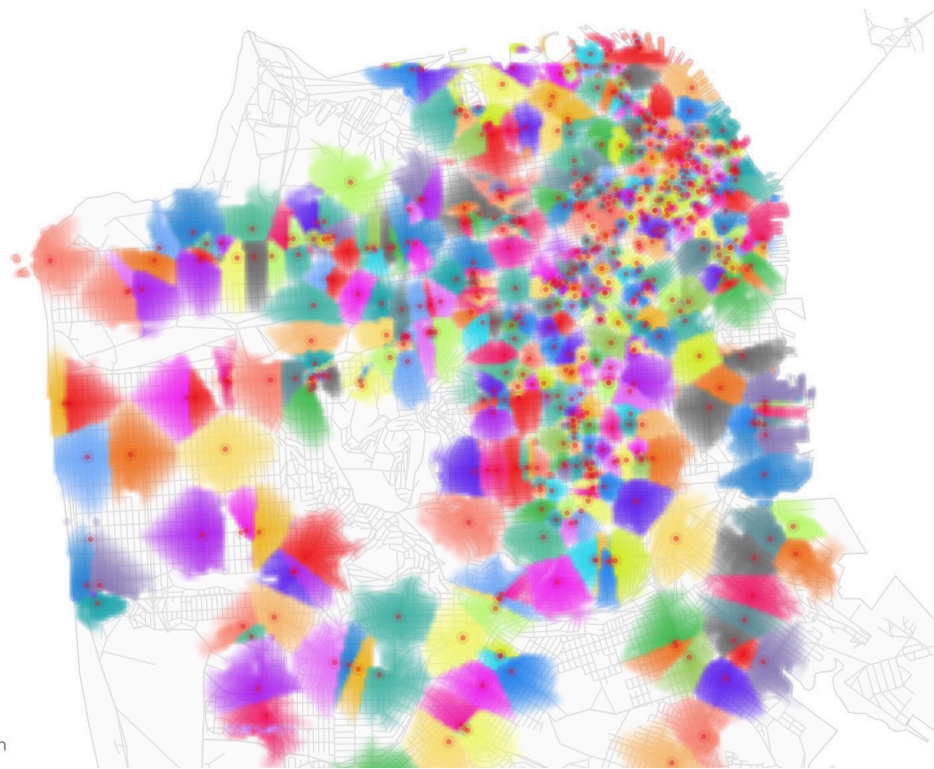
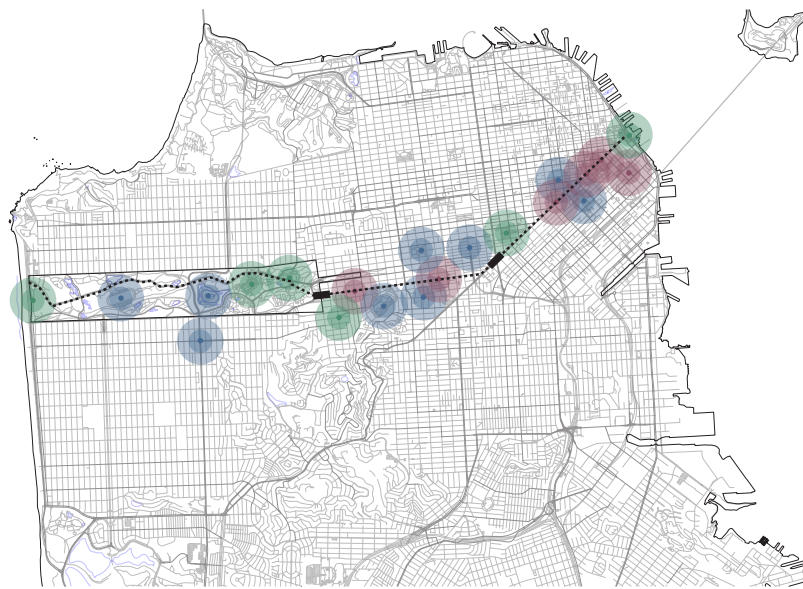


Figure 3.4: Photographer's Walking Path (adapted from <https://www.flickr.com/photos/walkingsf/>)

Figure 3.3: You Are Here (<http://youarehere.cc/>)



- Park Nodes
- Transit Nodes
- Landmark Nodes

Figure 3.5: Neighborhood Nodes



- "Missing" Links

Figure 3.6: Missing Links

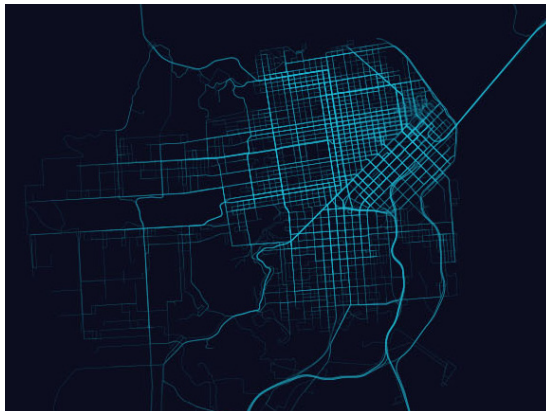


Figure 3.7: Uber Ride-Sharing Routes  
(<https://www.uber.com/100/>)

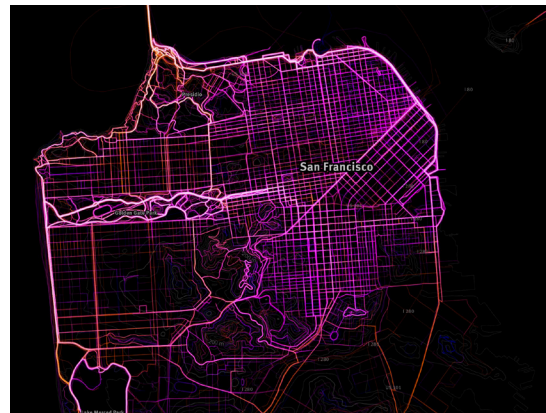


Figure 3.8: Runkeeper Walking Routes  
(<https://www.mapbox.com/blog/runkeeper-million-routes/>)

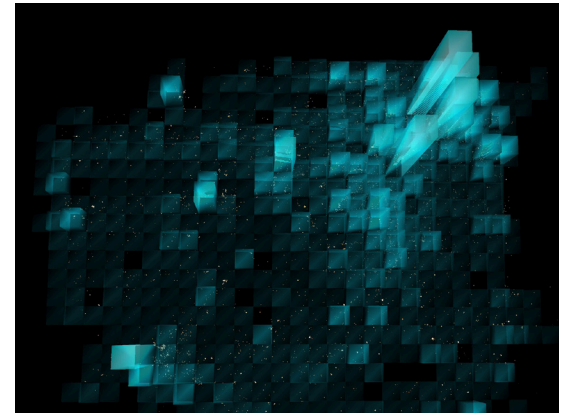


Figure 3.9: Geotagged Tweets  
(<https://www.mapd.com/demos/tweetmap/>)

## PATTERNS OF MOBILE TECHNOLOGY

Before examining the impact of mobile technology on these two sites, we must first understand how technology affects cities in general. Technology reshapes the physical city through six spatial patterns: the invisible city, the informative city, the social city, the responsive city, the shared city, and the placeless city. Today's smartphone apps seek to add value to the urban experience through a combination of these patterns (Figure 3.10).

In the *invisible city*, digital mapping allows hidden physical space to be found, the past remembered and the future projected (Figure 3.11). For example, Google Maps users can access a site-specific database of user-rated services, as well as an archive of historical panoramic views of a location. Including satellite imagery, maps, street views, route planning, and traffic conditions, as well as local business reviews, open hours, and contact information, the app is used by the pedestrian for navigation and to find local businesses tailored to one's individual needs. Layers of data augment the pedestrian's experience,

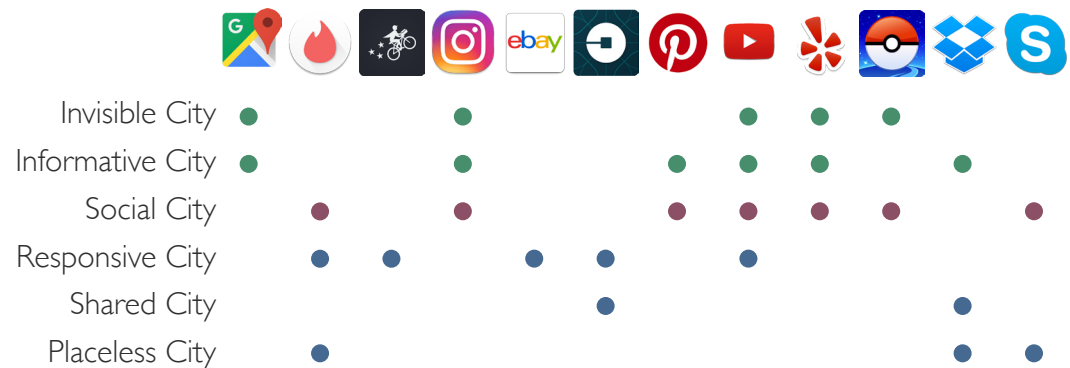
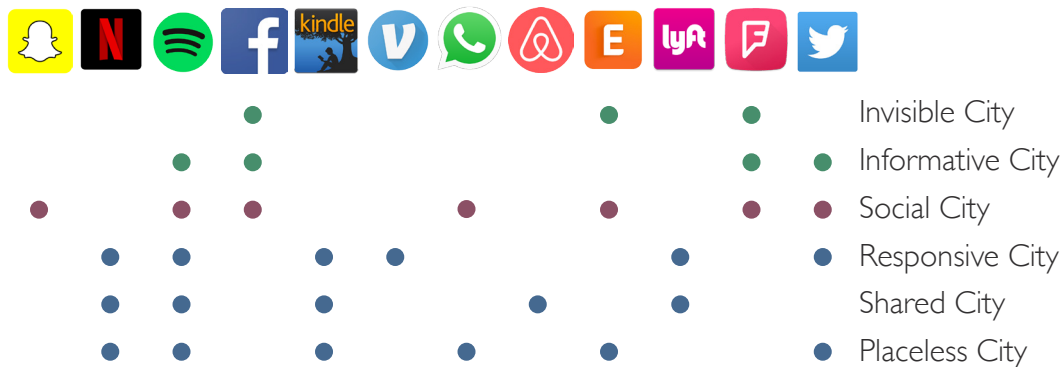


Figure 3.10: Patterns of Technology in Mobile Apps

modifying the importance of physical wayfinding signals. Thus, the invisible city can offer surprises that are not immediately obvious, but triggered by certain stimuli and searchable online.

In the *informative city*, data can be publicly created, shared, and visualized (Figure 3.12). For example, apps like Nextbus, Transit, and OneBusAway allow users to connect to GPS-equipped transit from their current location to quickly know how long until the bus arrives and where to catch it. In San Francisco, this data is open source, allowing developers to experiment, creating new apps, tools, and websites that relay this information in inventive, clear, and pretty ways. The user can choose their own preferred app from a myriad of options. Instead of waiting at the curb, relying on paper schedules and late busses, the user's extra minutes can be spent in their warm apartment or to buy a coffee. Location data is gathered to make layers of useful and interesting information accessible within the informative city.



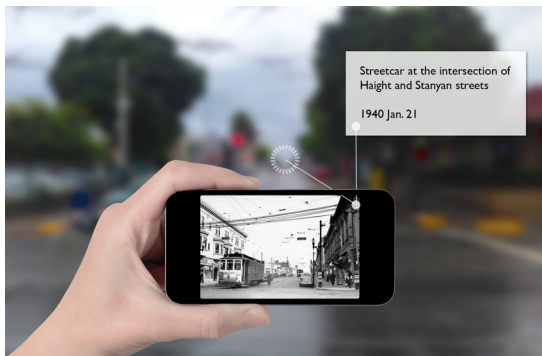


Figure 3.11: Invisible City



Figure 3.12: Informative City



Figure 3.13: Social City

In the *social city*, the street becomes a space where one can communicate while alone and feel alone while surrounded by others (Figure 3.13). Traditional social boundaries become flexible and intangible as the pedestrian adjusts their connectedness from moment to moment, tailoring their walk to personal desires for companionship or solitude. Whatsapp users send individual and group messages, photos, and videos anywhere in the world, allowing relationships and communities to stay in touch spontaneously and across distances. The social city reconfigures how a person seeks interaction.

In the *responsive city*, users expect services and spaces to be on demand and instantly available (Figure 3.14). The Postmates app connects users to a bicycle courier who can deliver food from any restaurant or goods from any store within an hour. Options open up as a restaurant is no longer responsible for also running an in-house delivery service. Instead of shipping items from their source, the app allows users to shop at their local stores with the benefits of quick delivery. Users have their shopping and culinary impulses met on a whim. Similarly, the responsive street will cater to the desire for instantly available public space.

In the *shared city*, smart infrastructure allows space to be efficiently used within the sharing economy (Figure 3.15). Lyft and Uber users ride with others heading in the same direction, allowing one car to be shared by multiple passengers. The passengers call the ride within minutes, even in locations not frequented by traditional taxis. These services

are replacing the need for personal cars among city dwellers, resulting in more carpooling and fewer parked cars in high land value areas. Just as with cars, the shared street will adjust to be used in different ways at different times, according to demand.

In the *placeless city*, space adapts to accommodate a mobile need where use is no longer restricted to a specific time and space (Figure 3.16). For example, Tinder users find dates without going to places where people have traditionally met other singles. A user can swipe through potential partners from any location, and mutually selected partners, elsewhere in the city, can respond and begin interacting. The user is no longer restricted to people who share their physical space, creating the possibility of meeting someone outside of the user's routine. Thus, in the placeless city, public space will become more flexible, allowing for spontaneous, informal programming.

Each of these six patterns is already changing the way people interact with the city. Mobile technology allows cities to become open source, where information is freely available and public space customizable. The city can respond to and harness these new behaviors to create an urban experience that is more intelligent, efficient, and individualized, where citizens have a greater sense of ownership and contribution. Design that responds to these changes will result in a public space that looks toward the future.



Figure 3.14: Responsive City



Figure 3.15: Shared City

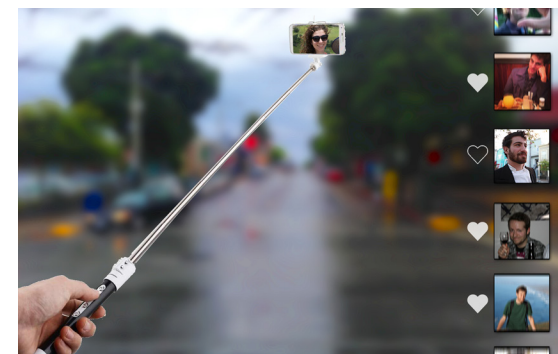


Figure 3.16: Placeless City

## SITE ANALYSIS AND PROGRAM

The six patterns of technology impact each place uniquely. This thesis proposes an analysis and design for two sites in San Francisco. Both sites fall into gaps shown in Figure 3.17. The first site is Market Street and Van Ness Avenue, a busy crossroads adjacent to numerous theater and music venues. The second is Haight Street and Stanyan Street, in a neighborhood hosting a long history of social and political activism, at the intersection that connects Haight-Ashbury to Golden Gate Park. This duality demonstrates the possibility for individualized placemaking within the universal framework proposed by this thesis.

These relationships between technology and site are analyzed through a series of diagrams that show how the inclusion of data onto each physical site contributes to a more intelligent, communicative, and efficient city. The first diagram maps the invisible and informative layers onto the site. The second maps the social city layer onto the site. The third maps the responsive, shared, and placeless cities onto the site. Representative, recent content from Google Maps, Flickr, and Twitter is used as data for the creation of these diagrams.

This thesis proposes three levels of design intervention to reveal the new qualities of the data integrated city: digital overlays, responsive displays, and built interventions. These layers build on each other progressively to activate missing links in the city.



Figure 3.17: Thesis Study Sites

A digital overlay (Figure 3.18), visible only using augmented reality through a mobile device, serves to enhance what already exists by exposing the invisible data collected on the site. Since this layer is entirely digital, it can exist along the whole path, but requires users to opt-in by choosing to view the site through a device. The data can respond to the users' unique interests and needs.

A responsive display (Figure 3.19) projects the wealth of digital information onto the physical city. Sensors detect changes in the space and signal an interactive light installation that makes the information visible. Pedestrians can then interface with this feature. The lightweight installation allows it to cover large swathes of the ground, a space that becomes more prominent as our eyes are directed downwards at our personal media screens. The display is passive, accessible to all users of the space. However, certain extra aspects may be available to a user who chooses to interact more directly with the installation. The data responds to the users, and the users, in turn, respond to the data.

The final layer, the built intervention (Figure 3.20), provides a physical place to inhabit these transformed spaces. These interventions are small units that can be deployed in a variety of underused areas, from parking spots to bus stops. These pedestrian rest stops provide places to cocoon and camp, to wander and promenade. Together, the digital overlay, responsive display, and built intervention create a new infrastructural layer to the city that reclaims urban space for public interaction.

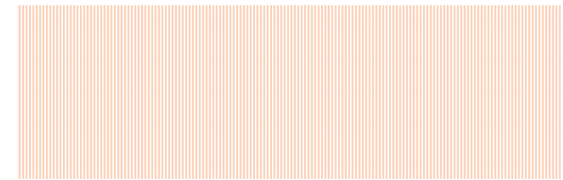


Figure 3.18: Digital Overlay

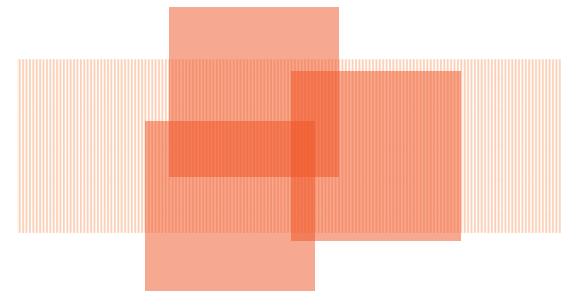


Figure 3.19: Responsive Display + Digital Overlay

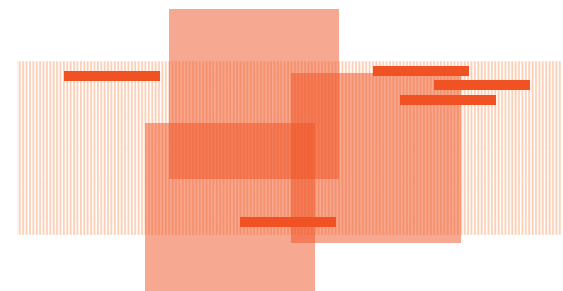


Figure 3.20: Built Intervention + Responsive Display + Digital Overlay



Figure 4.1: Physical Site: Haight & Stanyan

## CHAPTER 4

### ANALYSIS: HAIGHT & STANYAN

Haight Street is an important neighborhood commercial corridor. While parallel Fell and Oak Streets act as vehicular arteries, Haight Street serves a primarily pedestrian population. With the 1883 opening of a cable car line connecting Golden Gate Park to Market Street, the Haight developed quickly. A prominent pedestrian entrance to the park at Haight and Stanyan served as the original neighborhood node, populated by a dense cluster of shops, restaurants, saloons, and hotels surrounding the cable car turnaround.

The intersection at Haight and Stanyan (Figure 4.1) has not maintained its historic vibrancy. Where Haight Street unceremoniously ends at Golden Gate Park, a gap between the identified neighborhood nodes is associated with the perceived pedestrian experience. While much of the Haight is very walkable, this intersection does not feel inviting or safe. According to SF OpenData<sup>27</sup>, the intersection receives roughly 4.7 million pedestrians annually, more than the successful node at Haight-Ashbury. Yet walkers merely travel through. When viewed through the augmented lens of technology, the site offers more complexity than at first glance.

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27 "Map of Estimated Yearly Pedestrian Volume at Intersections," SF OpenData, last modified October 12, 2016, <https://data.sfgov.org/>



Figure 4.2: Haight Street and Stanyan Street Aerial

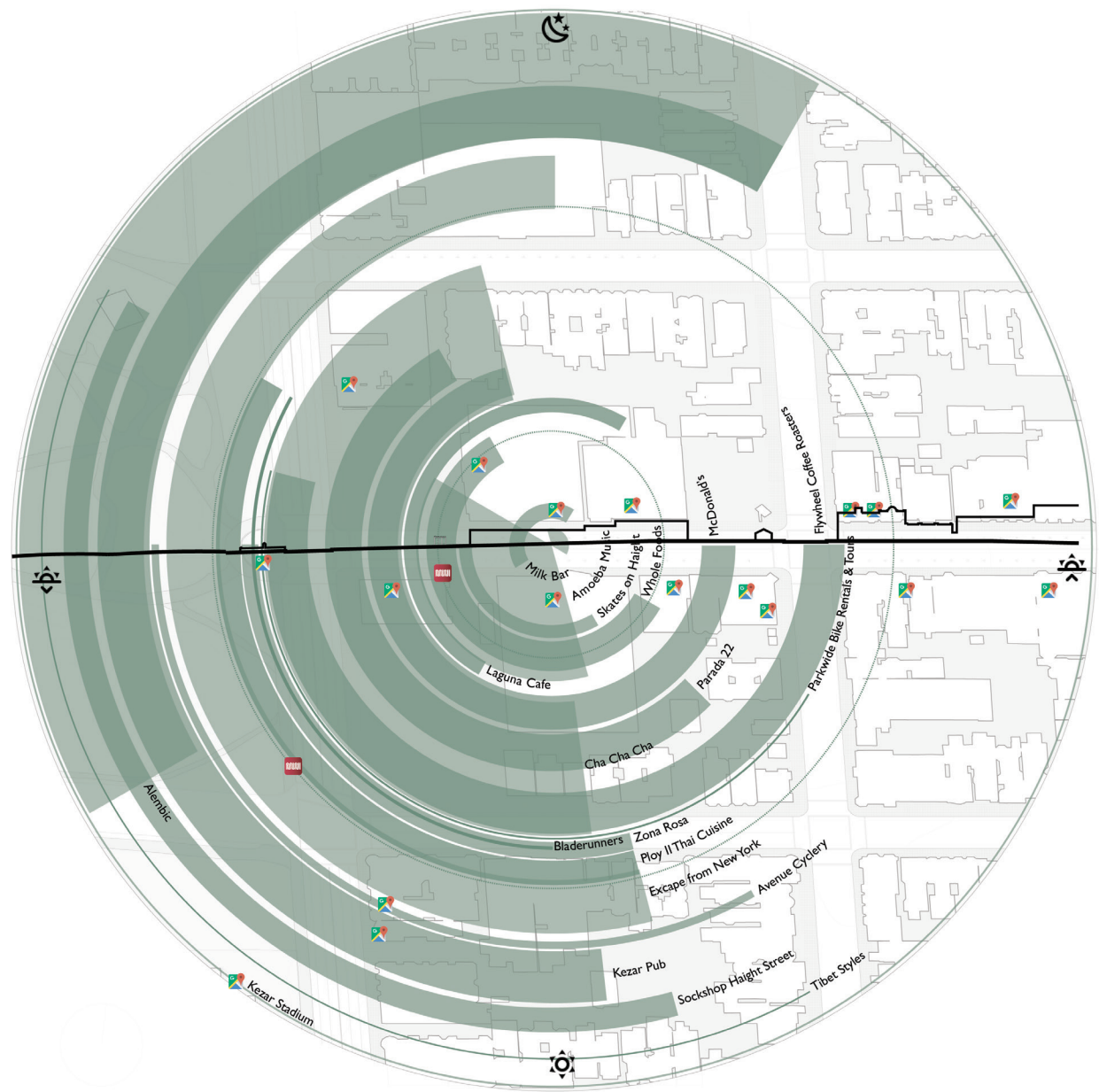


Figure 4.3: Invisible & Informative Patterns: Haight & Stanyan

## INVISIBLE & INFORMATIVE

Figure 4.3 diagrams the invisible and informative layers of the Haight and Stanyan site by displaying data about the businesses and amenities within a quarter mile of this intersection. The gap from the center represents the distance from the intersection, and the width of each band displays the relative number of reviews customers have written on Google Maps. Viewed as a 24 hour clock, with midnight at the top and noon at the bottom, the arc of each band shows the open hours of the amenity. In this diagram, the overlapping bands convey an imbalance in the number of customers frequenting these businesses. The businesses appear evenly spread, and the customer has multiple options available between 6AM and 2AM.

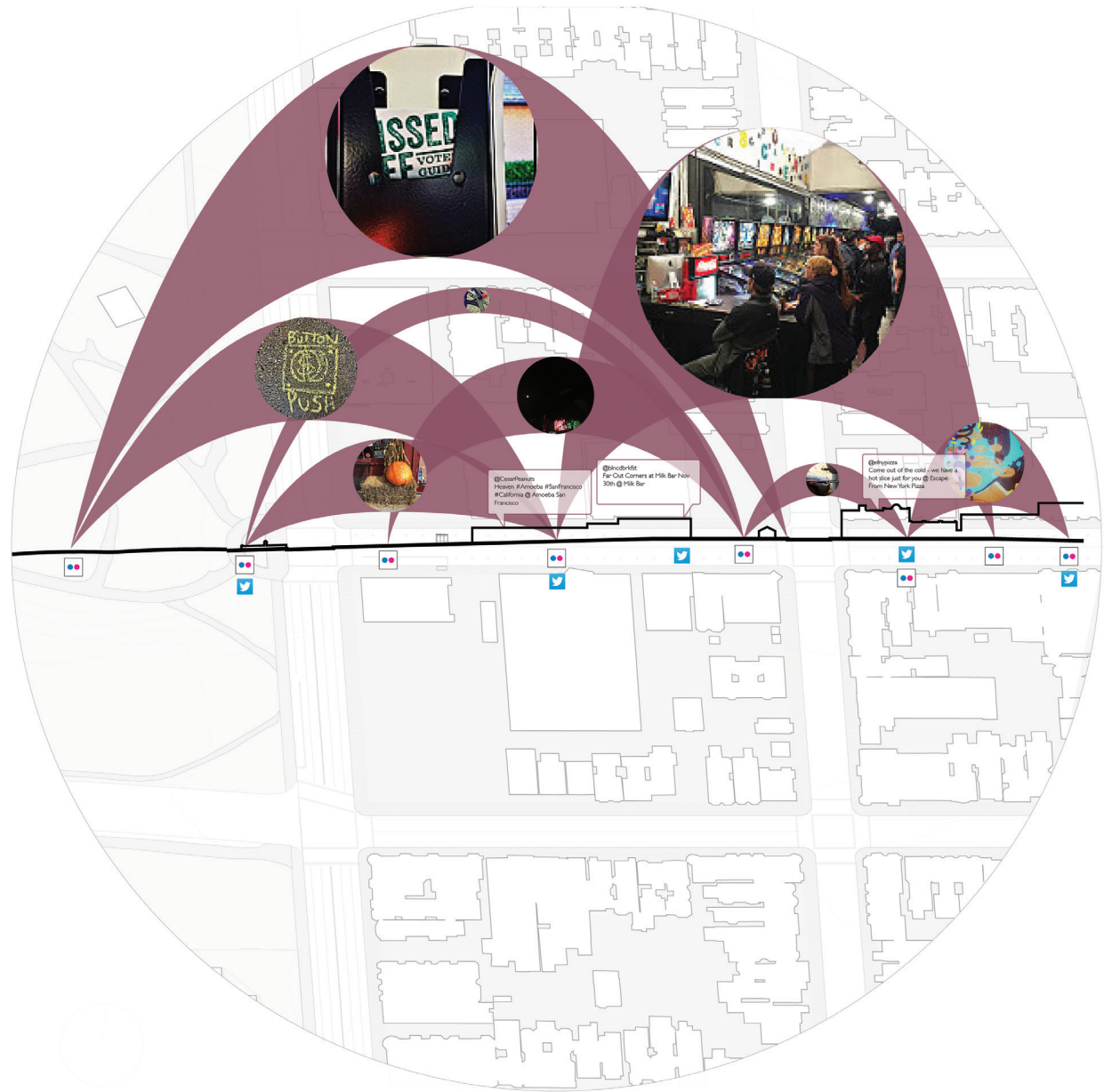


Figure 4.4: Social Patterns: Haight & Stanyan

## SOCIAL

Figure 4.4 describes the online communication happening in the social city. Flickr images and Twitter messages geotagged within a quarter mile of this location are shared digitally, across distances. The size of each image corresponds with the number of unique “views” recorded by Flickr, demonstrating the hierarchy of digital communication occurring here. A person walking alone can maintain a sense of connection through the availability of this digital conversation.

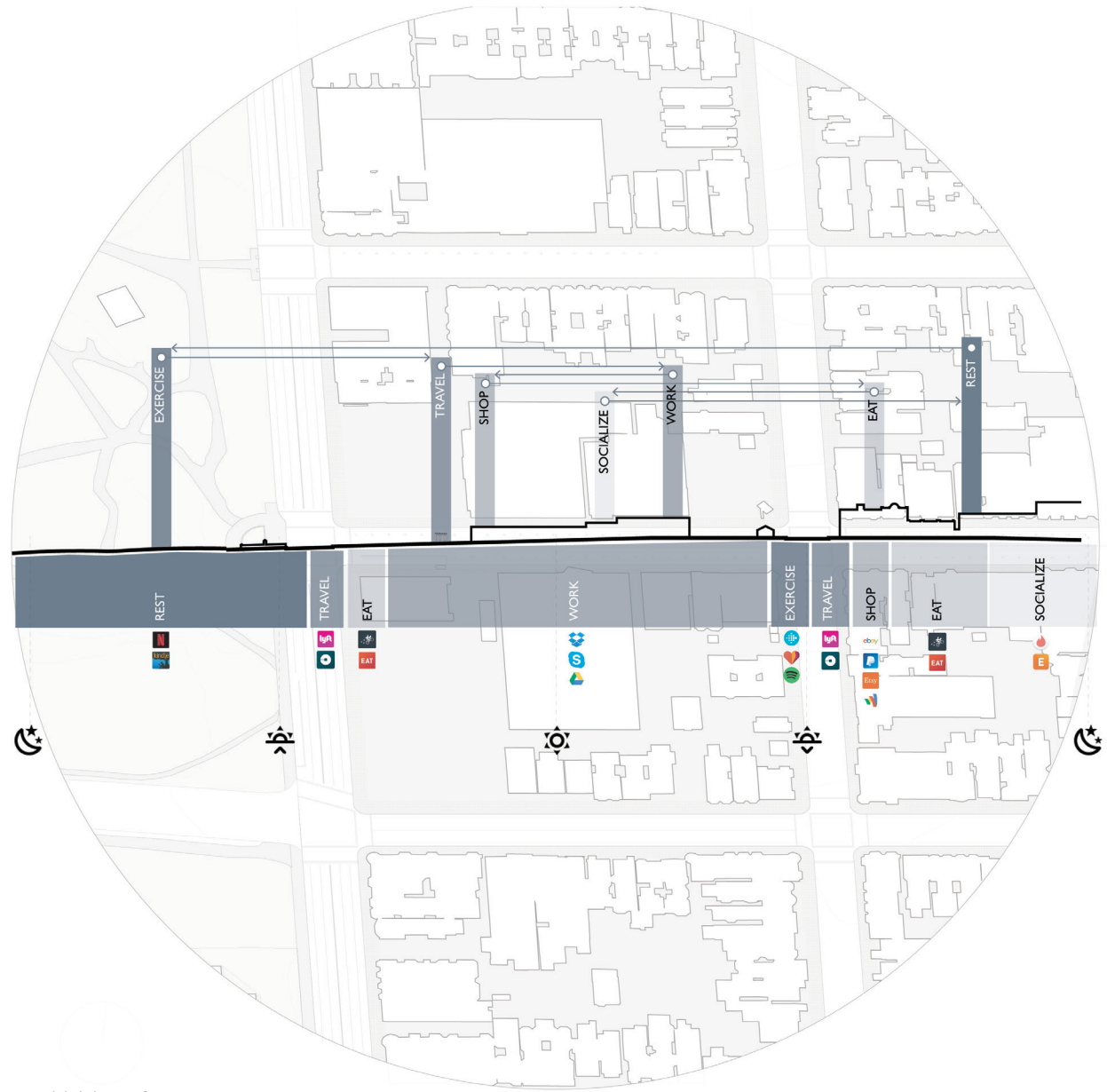


Figure 4.5: Responsive, Shared & Placeless Patterns: Haight & Stanyan

## RESPONSIVE, SHARED, & PLACELESS

Above the section in Figure 4.5, showing a conventional day, activities are place-based and scheduled. Below the section is a day in the responsive, shared, and placeless street, where use can happen independent of time and location. While a person used to rest at home to read or watch tv, such activities are now accessible anywhere using Kindle and Netflix. A gym used to provide access to a highly regimented, monitored workout. Today, Fitbit measures its user's daily activity and fitness, while integrating eating habits, weight changes, and sleep patterns to return holistic feedback without the expensive commitment of a gym. Meanwhile, Spotify helps the user develop a custom workout playlist.

This site is dominated by shopping and food. Retail stores and restaurants occupy the ground floors with housing above. Through digital tools, users outside the Haight can access these businesses, while users on the site can participate in activities that are inaccessible here.

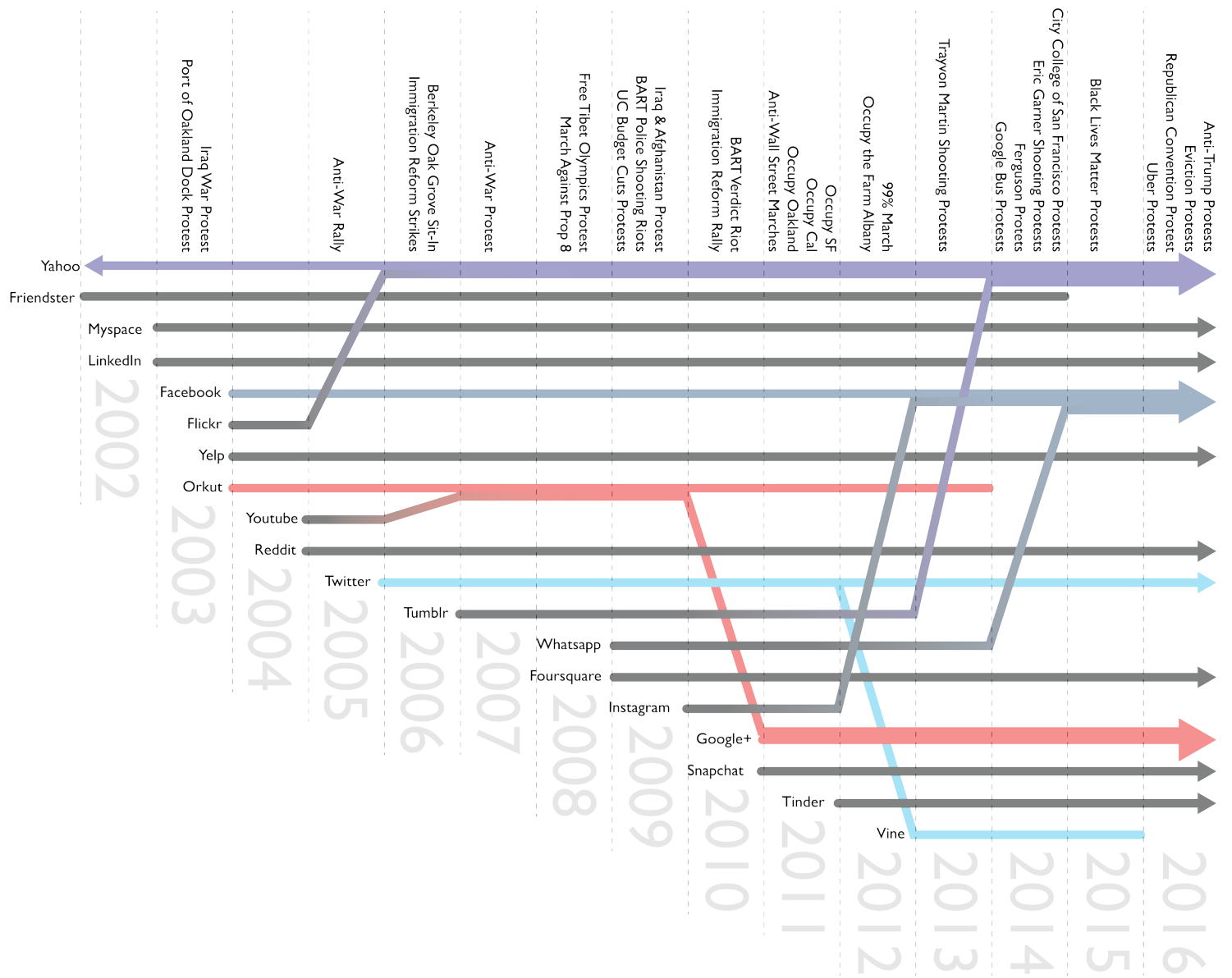


Figure 4.6: Timeline of Social Media and Bay Area Activism

## POLITICAL

In the 1960s and 70s, the Haight became a hotbed for social and political activism. Upper Haight Street and Golden Gate Park hosted key anti-establishment events, including the Human Be-In, the Summer of Love, the psychedelic rock scene, the Diggers' street theater, and the first free health clinic. Today this history is largely evoked through shops selling drug paraphernalia and tie dye t-shirts, vintage clothing boutiques, and crowds of tourists who come to the neighborhood on weekends, dressed as bohemians, to experience the gritty, hippy vibe. However, the tradition of activism survives in San Francisco, with a steady stream of protests, marches, and strikes, descendant activities of the 1960s counterculture in the Haight.

Figure 4.6 compares the growth of social media with Bay Area activism over the past fifteen years. Social media has played an increasingly important role in recent protest movements, as a means to advocate messages to a larger audience, and to collectively plan and recruit for events in the city. Grassroots activism already has a reciprocal relationship between virtual and physical space.

DESIGN: HAIGHT & STANYAN

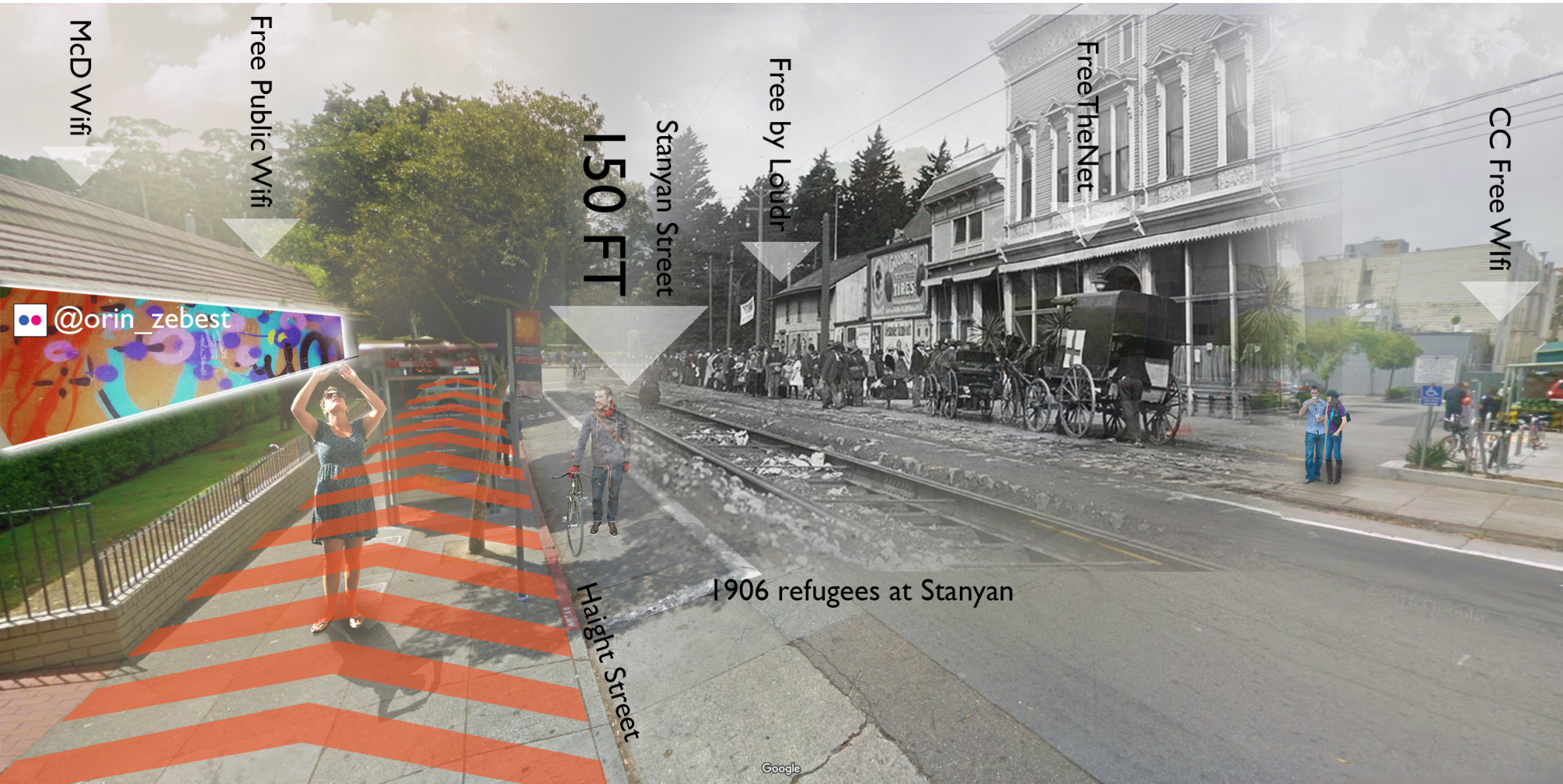


Figure 4.7:View of Digital Overlay on Haight Street

Figure 4.8:View without Augmentation (opp.)

## DIGITAL OVERLAY

The digital overlay is a virtual experience that serves to augment the physical city. In Figure 4.7, the path to and location of the approaching responsive display is marked, notifying a user who chooses to engage with the digital overlay. A historic photo taken from the same perspective shows the street as it looked following the 1906 earthquake, with buildings lining today's Whole Foods parking lot. Recent Flickr photos taken nearby enliven blank facades. Free wifi networks are mapped to guide someone searching for a place to pause.

In Figures 4.7 and 4.19, all these layers of information are shown at once. In a true augmented reality application each of these variables could be filtered, allowing experiences tailored to each user.<sup>28</sup> A tourist may use the navigation layer for wayfinding, while a resident who walks this block every day may seek fresh experiences, such as the realtime instagram feed. As technology improves, gesture, audio, and haptic feedback would work to more seamlessly integrate the virtual and the physical.



28 See Appendix A.

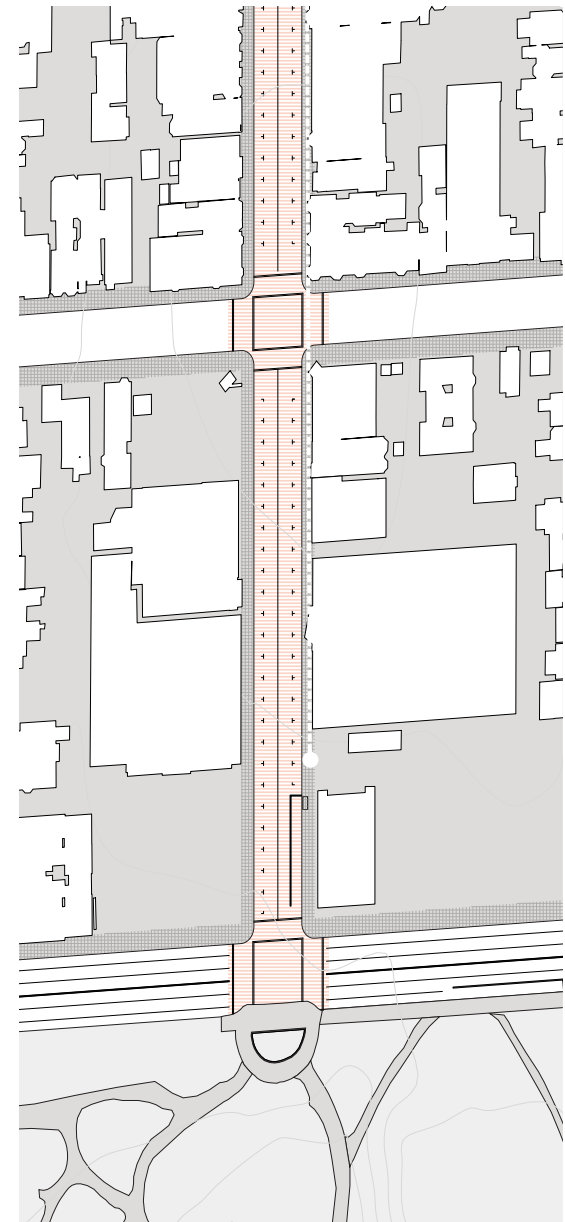


Figure 4.9: Digital Overlay: Haight & Stanyan

*"Hope will never be silent." — Harvey Milk*



Figure 4.10: View of Responsive Display at Haight & Stanyan

## RESPONSIVE DISPLAY

A pedestrian scramble, where all vehicles stop and pedestrians can cross the intersection diagonally, temporarily reprioritizes the street for walkers. During these periods, light projected from above trails behind each pedestrian who enters the road (Figure 4.10). These “footprint” of light are controlled by pressure and proximity sensors that read the action on the street. Sensors can also read temperature and light levels to adjust the display for time of day and changing weather. The system can be tuned to operate longer for special events, such as rallies or marches.

Walkers can interact with the display passively or actively. A famous quote from one of San Francisco’s numerous political leaders and activists is traced on the pavement in the light behind each pedestrian. As a function of the digital overlay, approaching pedestrians can choose from a selection of quotes, or even write their own statement. The light lingers until the vehicular traffic signal turns green, allowing the street display to grow into a web of interlaced, realtime commentary.

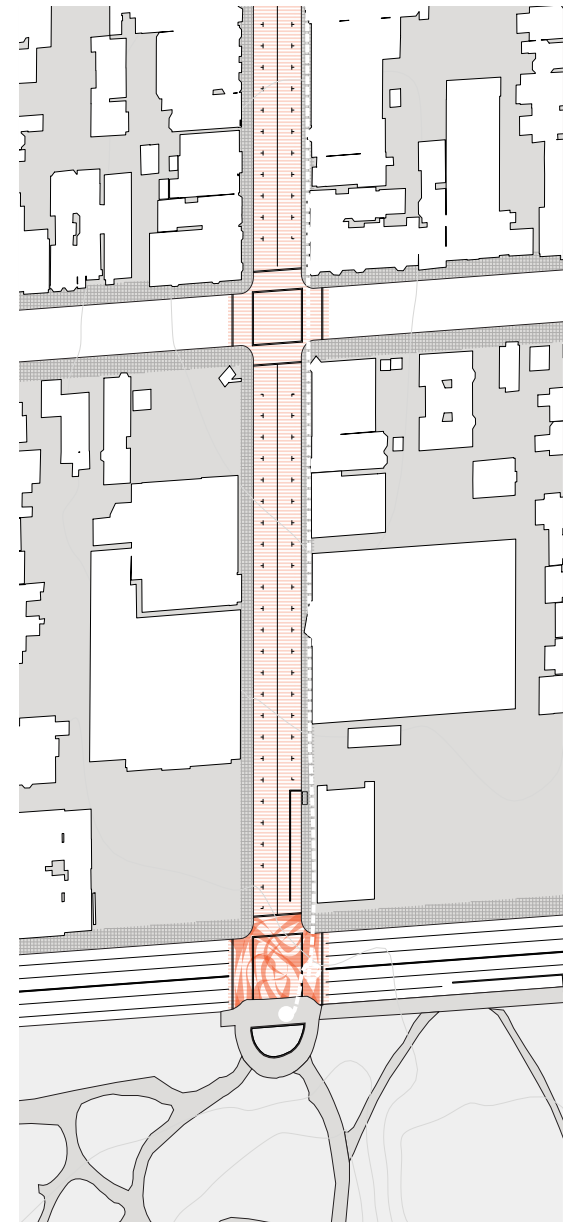


Figure 4.11: Responsive Display: Haight & Stanyan



Figure 4.12: View of Built Intervention at Haight & Stanyan

## BUILT INTERVENTION

In the Haight, the built intervention creates habitable space along empty street edges and in parking spots (Figure 4.12). The dead end of Haight Street abutting Golden Gate Park enables the interventions to mark this entrance at the approach of a pedestrian.

These units create flexible areas for gathering near the responsive display. When grouped together, their space becomes more interactive and multi-functional, as the components layer to form new combinations of seating, surfaces, and shelter. Users can claim a resting place or workspace that takes advantage of the social atmosphere of the street, a place where they can charge their devices and use them to gain access to all the layers of the open source city.

The built interventions, responsive display, and digital overlay all incorporate technology to enhance the experience of the city. At Haight and Stanyan, they build a link between existing neighborhood nodes while promoting a platform for political action.

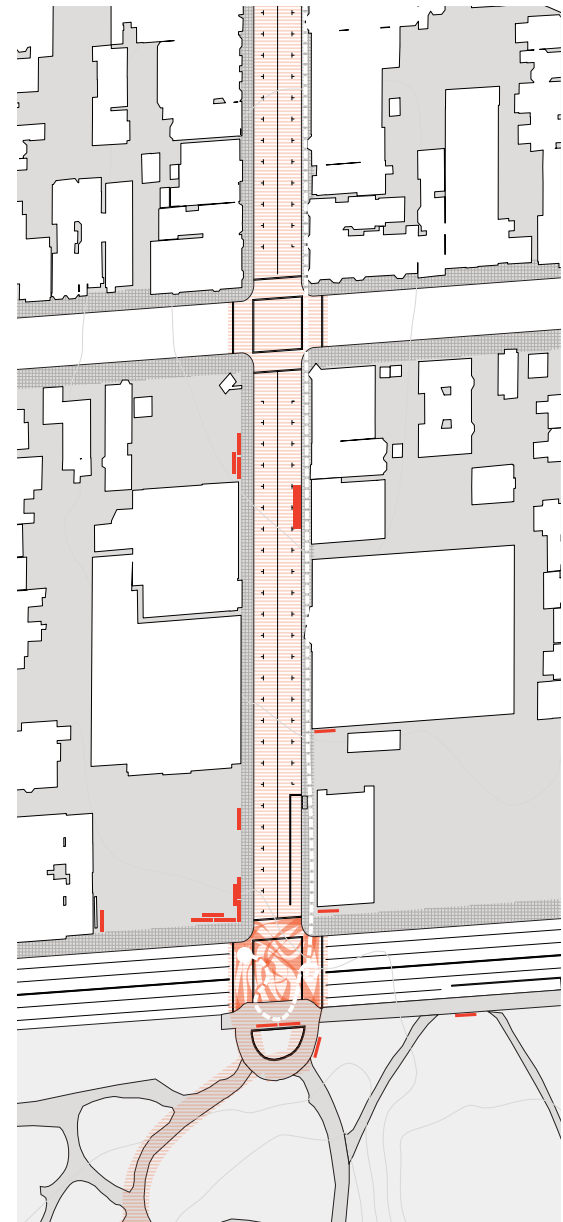


Figure 4.13: Built Intervention: Haight & Stanyan



Figure 4.14: Physical Site: Market & Van Ness

## ANALYSIS: MARKET & VAN NESS

The intersection of Market Street and Van Ness Avenue (Figure 4.14) is an important transit site in the city. It offers one of few transfer points between north-south and east-west bus lines as well as access to the underground MUNI station. These two arterials link the residential neighborhoods of San Francisco to the business-oriented Financial District and SOMA. According to SF OpenData, the intersection receives roughly 6.8 million pedestrians annually, more than the successful node at Hallidie Plaza, the juncture of 5th, Powell, and Market streets.

However, this intersection is not pedestrian friendly or human-scaled. Prominent businesses like the car dealership do not form a welcoming street wall. Office workers swarm the intersection in the commute hours, wary of the homeless that gather on the sidewalks. It is a place for travel only. Figures 4.15, 4.17, and 4.18 analyze the same patterns of technology as at Haight and Stanyan, but this time extracting data from the 1/8 mile radius around Market and Van Ness. The following diagrams of mobile technology reveal additional layers of the site.

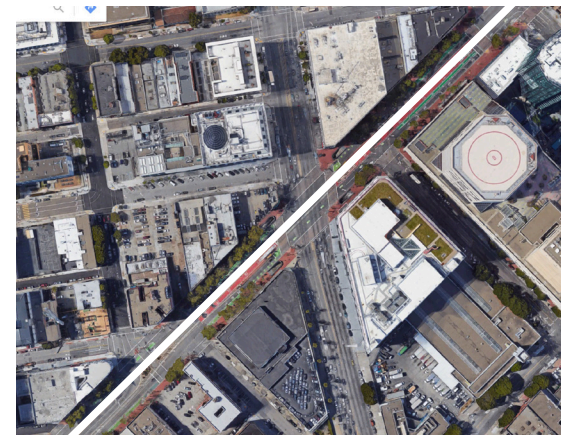


Figure 4.15: Market Street & Van Ness Avenue Aerial

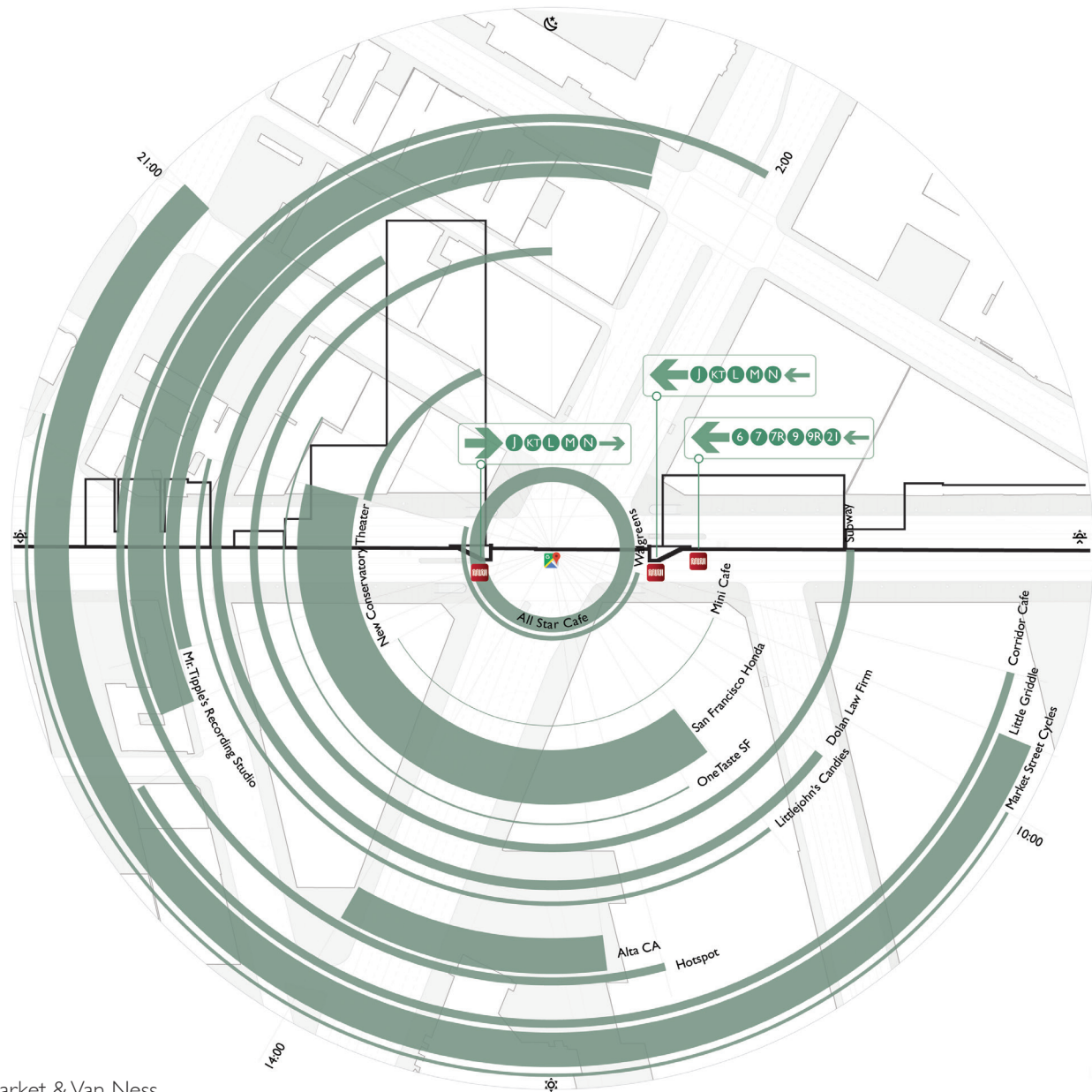


Figure 4.16: Invisible & Informative Patterns: Market & Van Ness

## INVISIBLE & INFORMATIVE

Figure 4.16 diagrams the invisible and informative layers using Google Maps data to display the distance, number of reviews, and open hours of nearby amenities. The diagram reveals few amenities at the intersection, with more businesses appearing further out. Most of these are open in the afternoon and early evening, with relatively little variation in the number of customers. The MUNI lines are heavily used, with many passengers entering the system, heading downtown, and others departing towards the western neighborhoods.

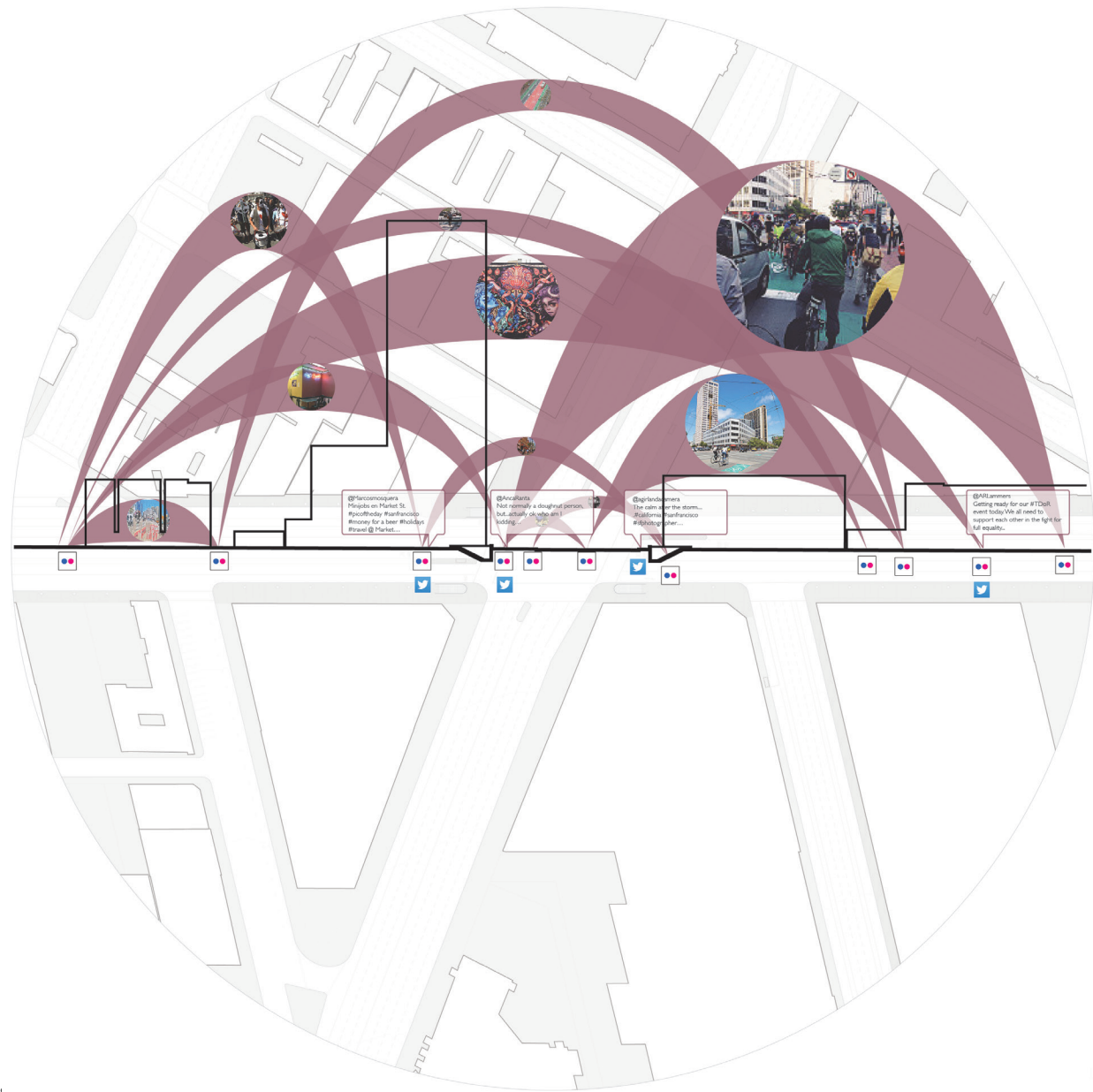


Figure 4.17; Social Patterns: Market & Van Nes:

## SOCIAL

Figure 4.17 describes the social city using geotagged Flickr images and Twitter messages.

The scalar relationships between the images conveys online conversation that dominates the digital imprint of this site, with an image of a busy bicycle commute receiving the most views.

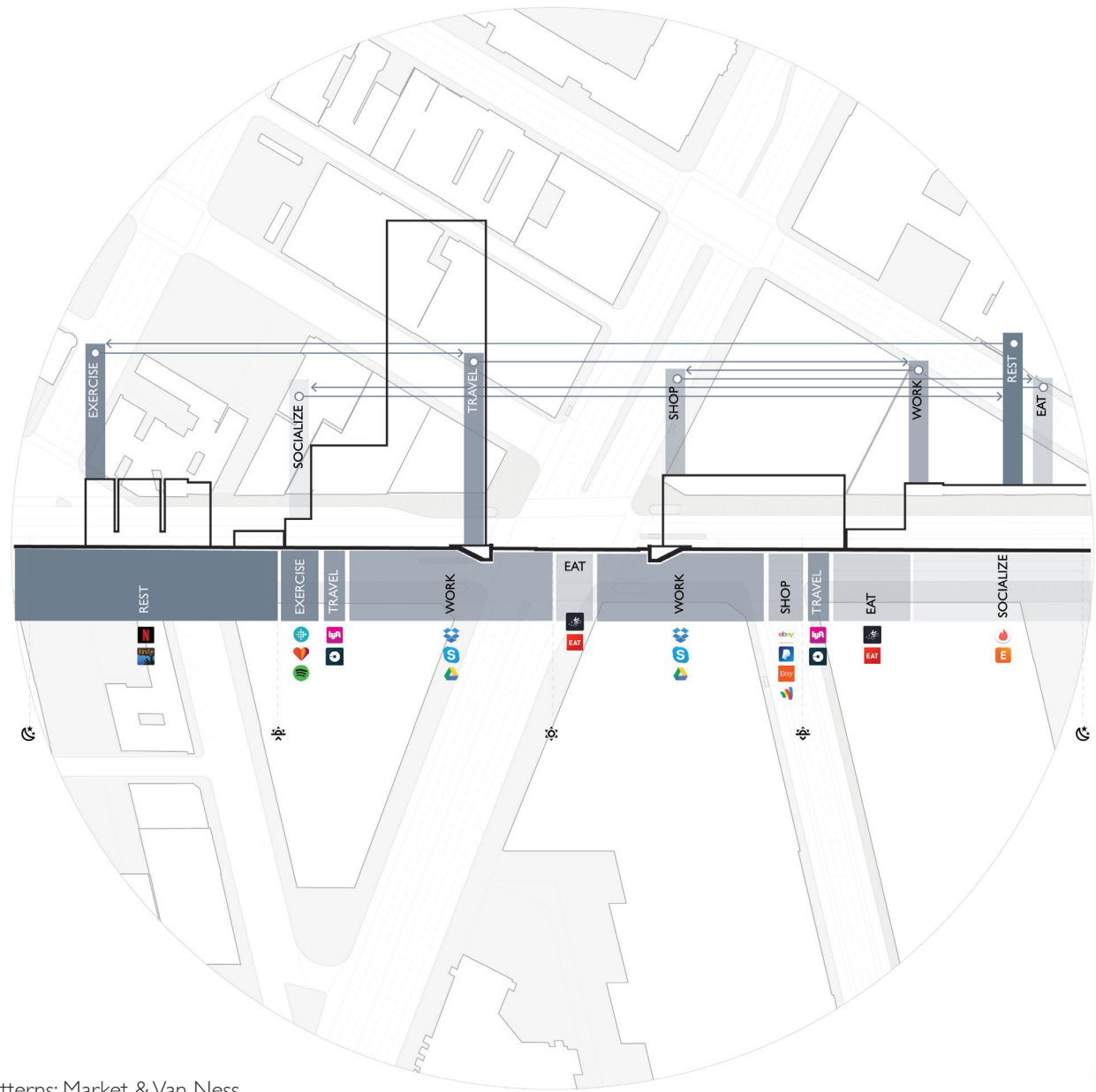
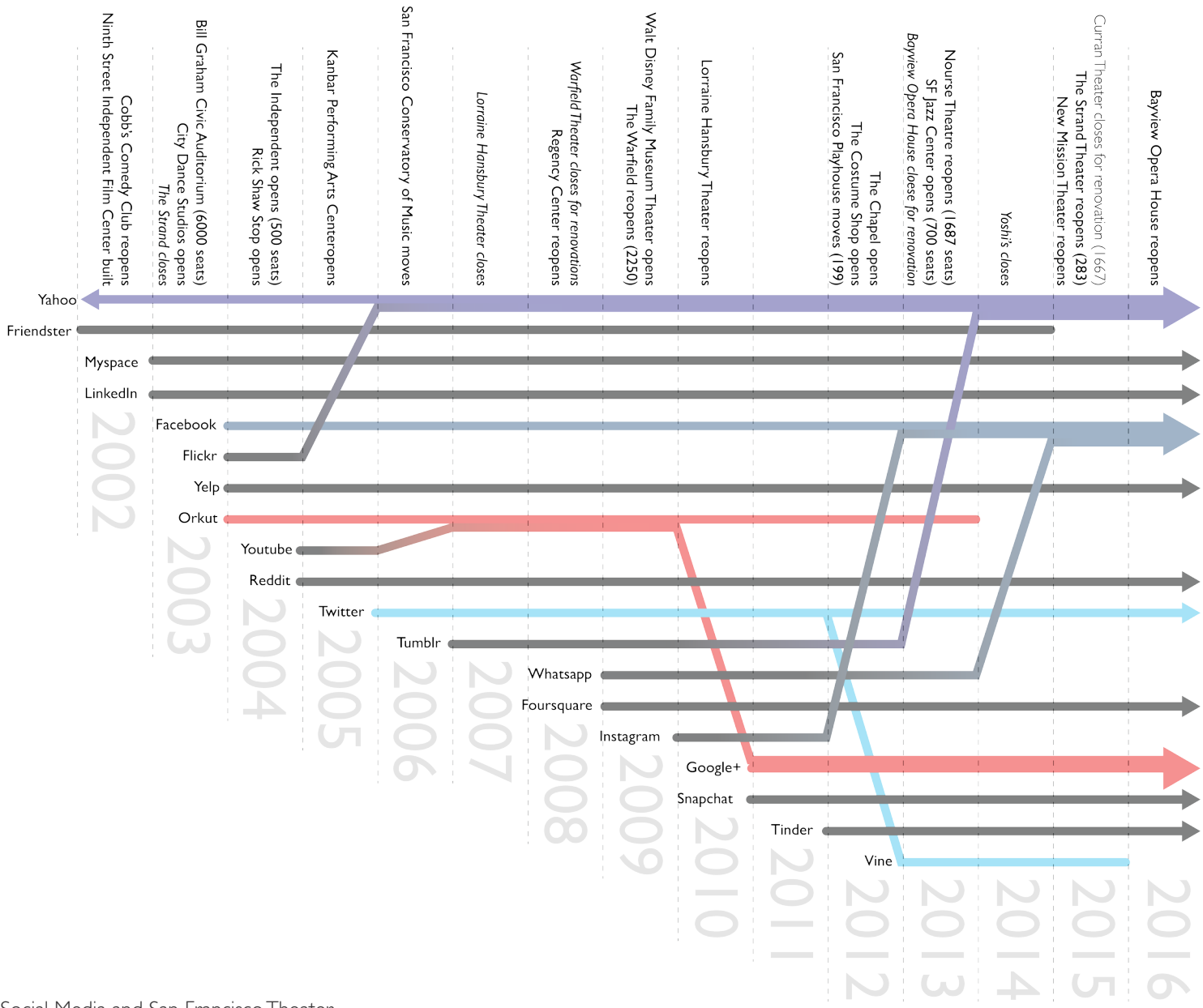


Figure 4.18: Responsive, Shared & Placeless Patterns: Market & Van Ness

## RESPONSIVE, SHARED, & PLACELESS

In Figure 4.18, a flexible and efficient street incorporates the responsive, shared, and placeless layers. A conventional day above the section is replaced by the digitally enhanced day below where apps allow activities to be unrestricted to time and place. Market and Van Ness offers amenities that fill some needs more than others. There are gastropubs and fast food cafes that cater to office workers at lunchtime and evening visitors attending the nearby theaters. However, there is little housing or retail. Using mobile technology to access the placeless, shared, and responsive city, the site accommodates more activities than those offered by the existing, location-based amenities.



## THEATRICAL

Finally, this site is influenced by its proximity to a major cluster of the city's theaters and performance spaces, including the homes for the San Francisco Opera, the San Francisco Symphony, and the San Francisco Ballet.

Figure 4.19 demonstrates a relationship between the last fifteen years of change in the media landscape and the local theatrical landscape. Social media plays a key role in the distribution of independent reviews, personal recommendations, and official advertising for the arts. Additionally, as film and music become available online instantly and for free, the live show is taking over the role of record sales in building livelihoods for new artists. Just as the businesses on the site serve theatergoers, public space in this district should reflect and enhance this local flavor.

## DESIGN: MARKET & VAN NESS

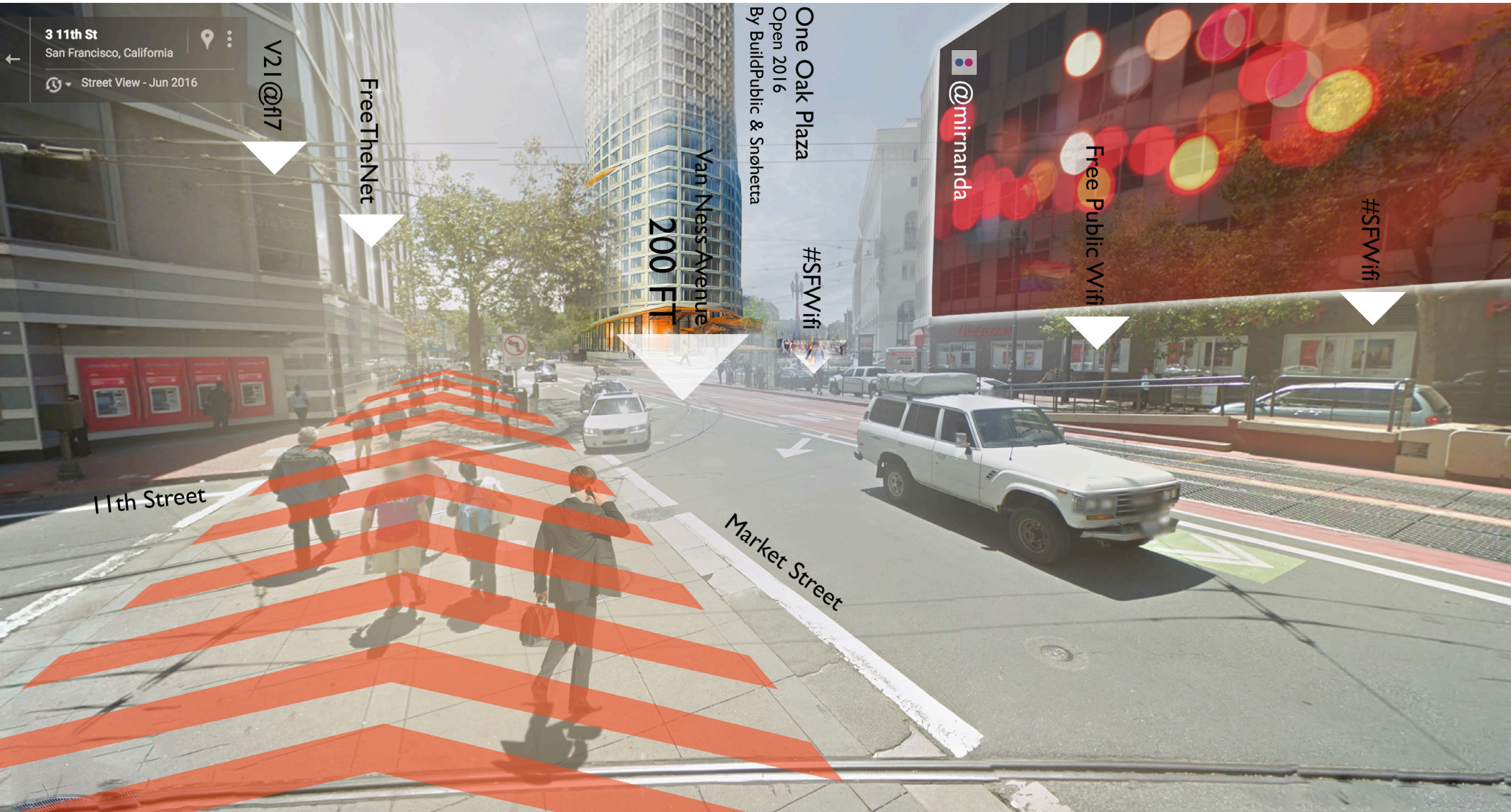


Figure 4.20:View of Digital Overlay on Market Street  
Figure 4.21:View without Augmentation (opp.)

## DIGITAL OVERLAY

Through the digital overlay (Figure 4.20), the user can highlight public space and wayfinding to guide them to the responsive display at the intersection. The future is projected with information about upcoming construction, informing the citizen about their city's plans. Local free wifi origins are identified. Photos taken by passerbys can be shared on nearby buildings so their facades begin to have a back and forth relationship with the pedestrian, adding accessible memories and flux to the physical space. The digital overlay augments the physical city by displaying its hidden information. These layers of information are shown at once, but in application, each of these variables could be filtered so the information could be viewed clearly.<sup>29</sup>



29 See Appendix A.

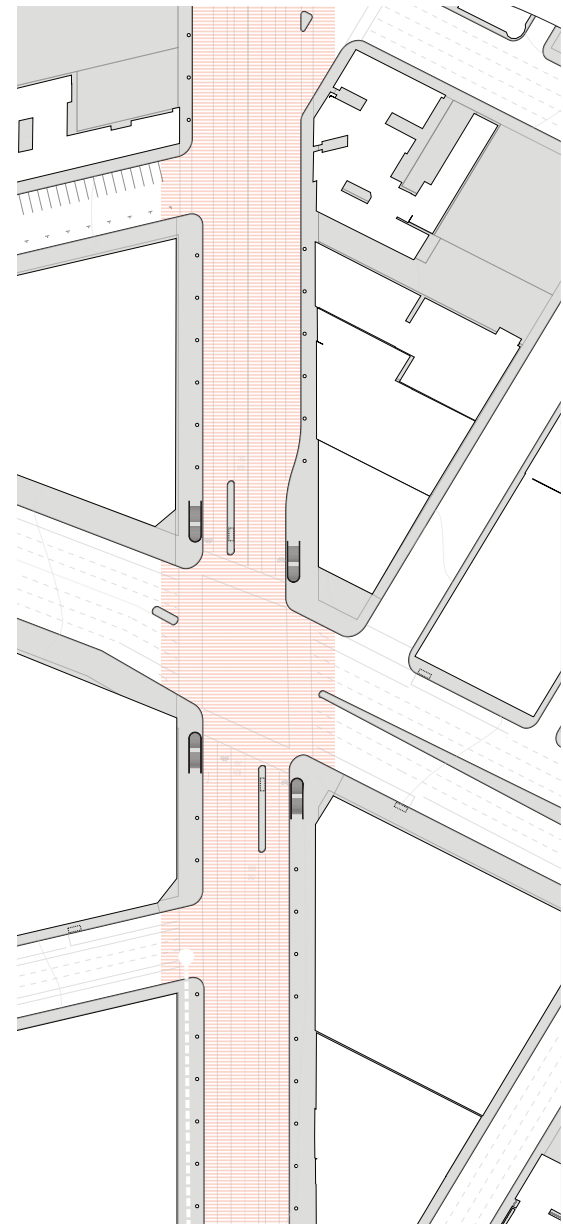


Figure 4.22: Digital Overlay: Market & Van Ness

*"I can walk down the streets of San Francisco, and here I'm normal." — Robin Williams*



Figure 4.23: View of Responsive Display at Market & Van Ness

## RESPONSIVE DISPLAY

During the pedestrian scramble, spotlights transform the intersection, replacing the car-filled intersection with a vibrant public space. The system can be tuned to operate longer for special events.

As pedestrians enter the street, light follows them, leaving a unique trail of their movement (Figure 4.23). Smart sensors activate the lights and adjust the display for time of day and weather. Reflective aggregate and paint in the intersection enhances the effect.

The responsive display engages the pedestrians and promotes dancing. Freed from concerns of vehicular traffic, a walker may trace the pools of light created by others, or take an indirect path to draw a unique shape with their own light. In this way, the installation grows, with people creating art that draws more people who create more art.

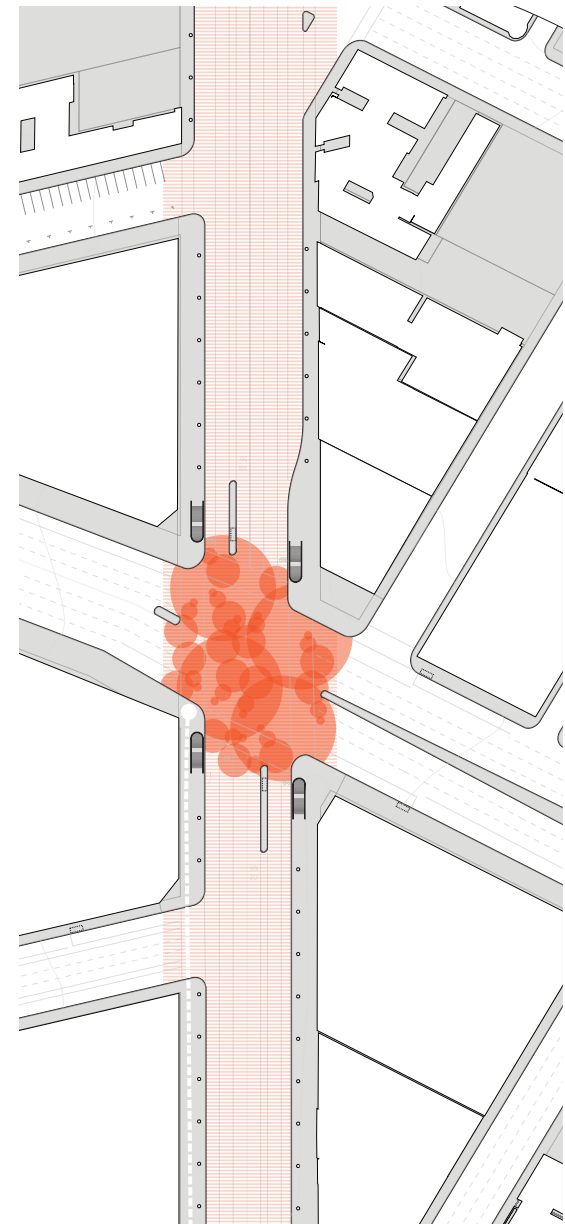


Figure 4.24: Responsive Display: Market & Van Ness



Figure 4.25: View of Built Intervention at Market & Van Ness

## BUILT INTERVENTION

Built interventions surrounding Market and Van Ness provide platforms for performance and audience space to enjoy the show of the responsive display. As the only pedestrian-scaled shelter, these installations promote gathering. They are a place to sit, to rest, to check your phone and access wifi. Unique spaces created by the multiple adjacent strips of furniture create individualized spaces for solitude or for group conversations. They form a backdrop for buskers and street performers who gather near people waiting for transit.

The built interventions, responsive display, and digital overlay work together to augment the pedestrian's experience. At Market and Van Ness, they build a link between existing neighborhood nodes, providing a public stage that encourages impromptu art, theater, and music production. Through these interventions, the pedestrian can visualize and access the layers of the open source city.

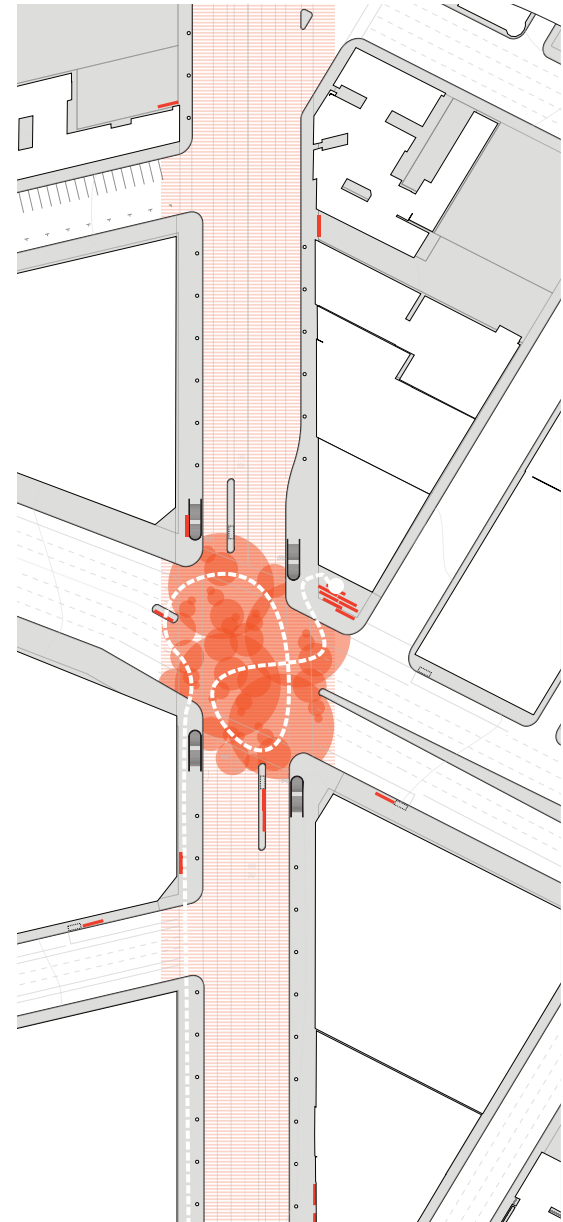


Figure 4.26: Built Intervention: Market & Van Ness



## CHAPTER 5

### CONCLUSION

Applying the framework of this thesis to two sites (Figure 5.1), this thesis explores the adaptability of these concepts to any site. These studies could be applied to multiple locations along this traverse through San Francisco, to other locations in the city, or to other cities. The series of interventions exhibit a new design for public space that is responsive to the ever-changing conditions of the city.

As data is hidden but the built environment is tangible, this research seeks to make this invisible world physical through architecture. Dissonance affects the design and the analysis. A hidden world, unmoored from space, is represented through visual diagrams. This thesis explores the relationships between virtual and physical worlds.

Proposing a future where information is seamlessly incorporated into the city, we cannot yet provide all the necessary steps to reach that point. The use of big data lags behind its collection. It is difficult to adapt digital information for public consumption due to the struggle to organize massive amounts of data into digestible, legible components. An ideal, but challenging use of technology would be an integration that enhances the daily experience of the city.

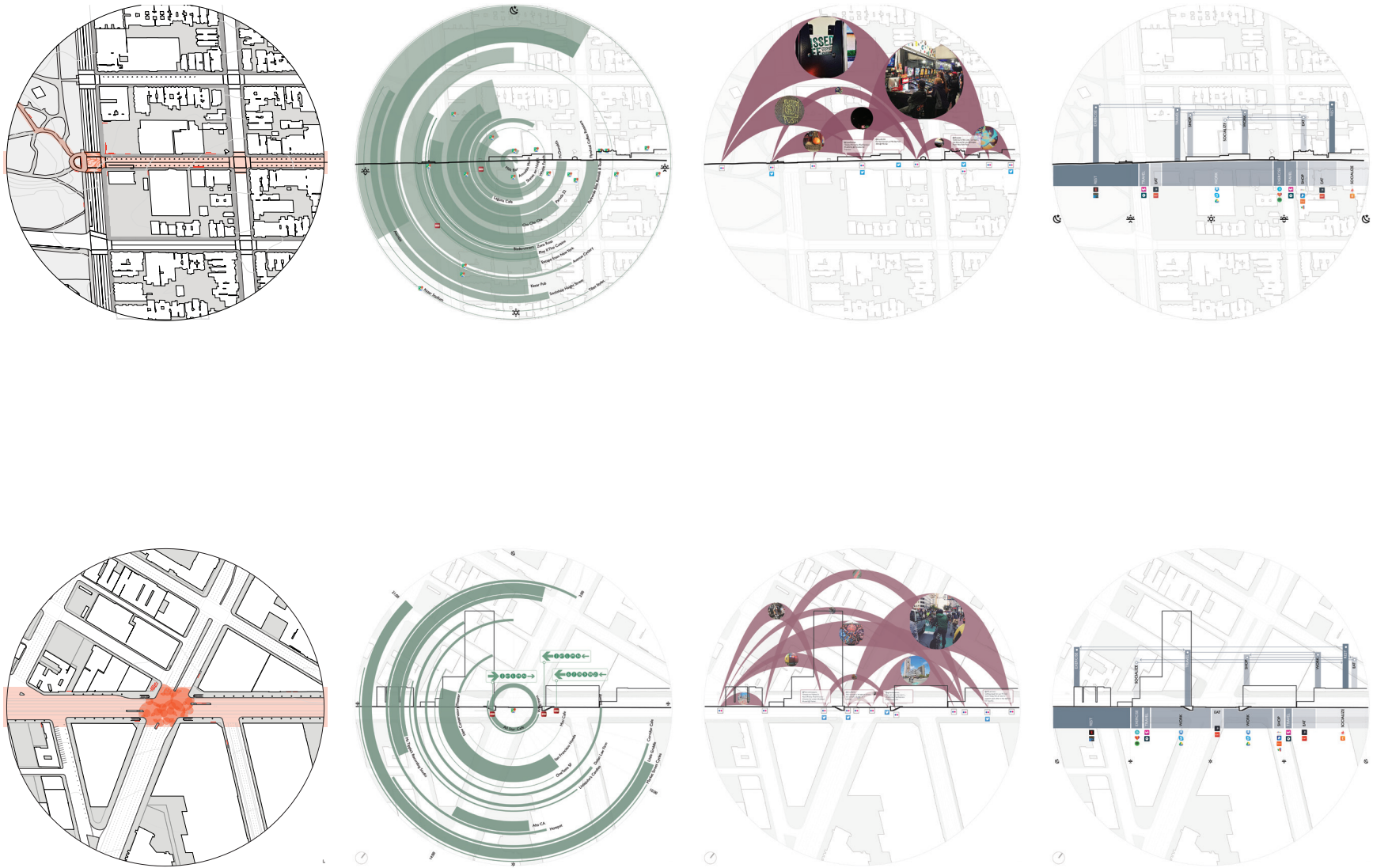


Figure 5.1: Comparison of Two Sites

Further, the technological world changes quickly. Some of the patterns of technology represented in this thesis have only become apparent in the last few years. Surely, new technological implications will arise in the future and affect the built environment, while others may fade. Even as the process of writing this thesis unfolded, world events have exposed aspects of technology that could not be not dealt with herein.

Collectively, the digital overlay, responsive display, and built intervention create a new infrastructural layer that reclaims urban space for public use (Figure 5.2). Digital interaction fuses with public interaction to create a strengthened, unified interaction that merges the virtual and physical worlds. This thesis serves as a prototype of analysis and design for the integration of architecture and technology that improves the public realm.

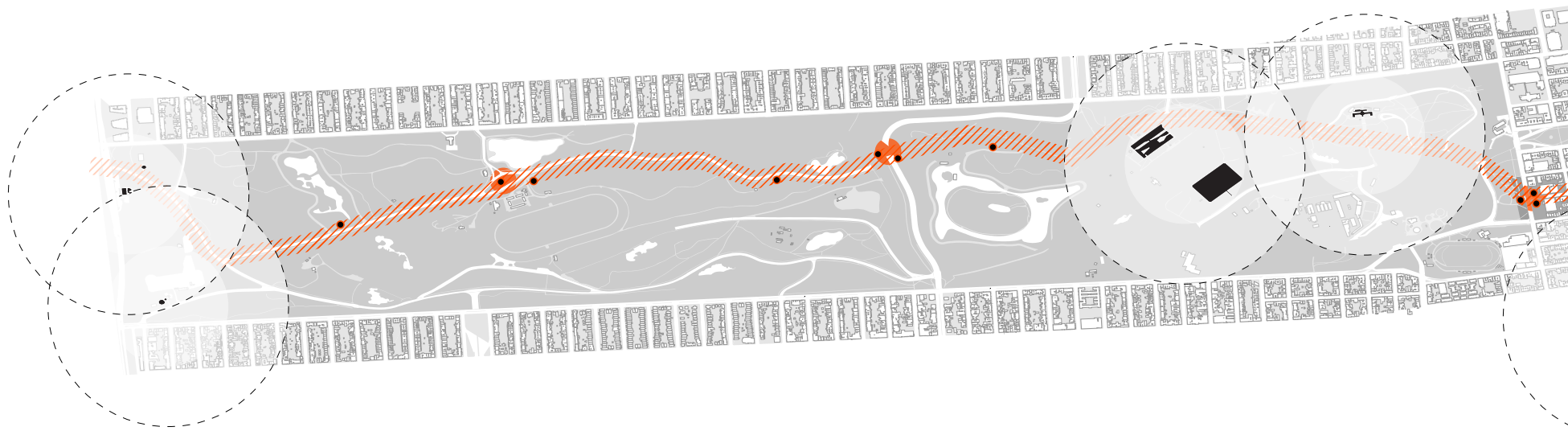
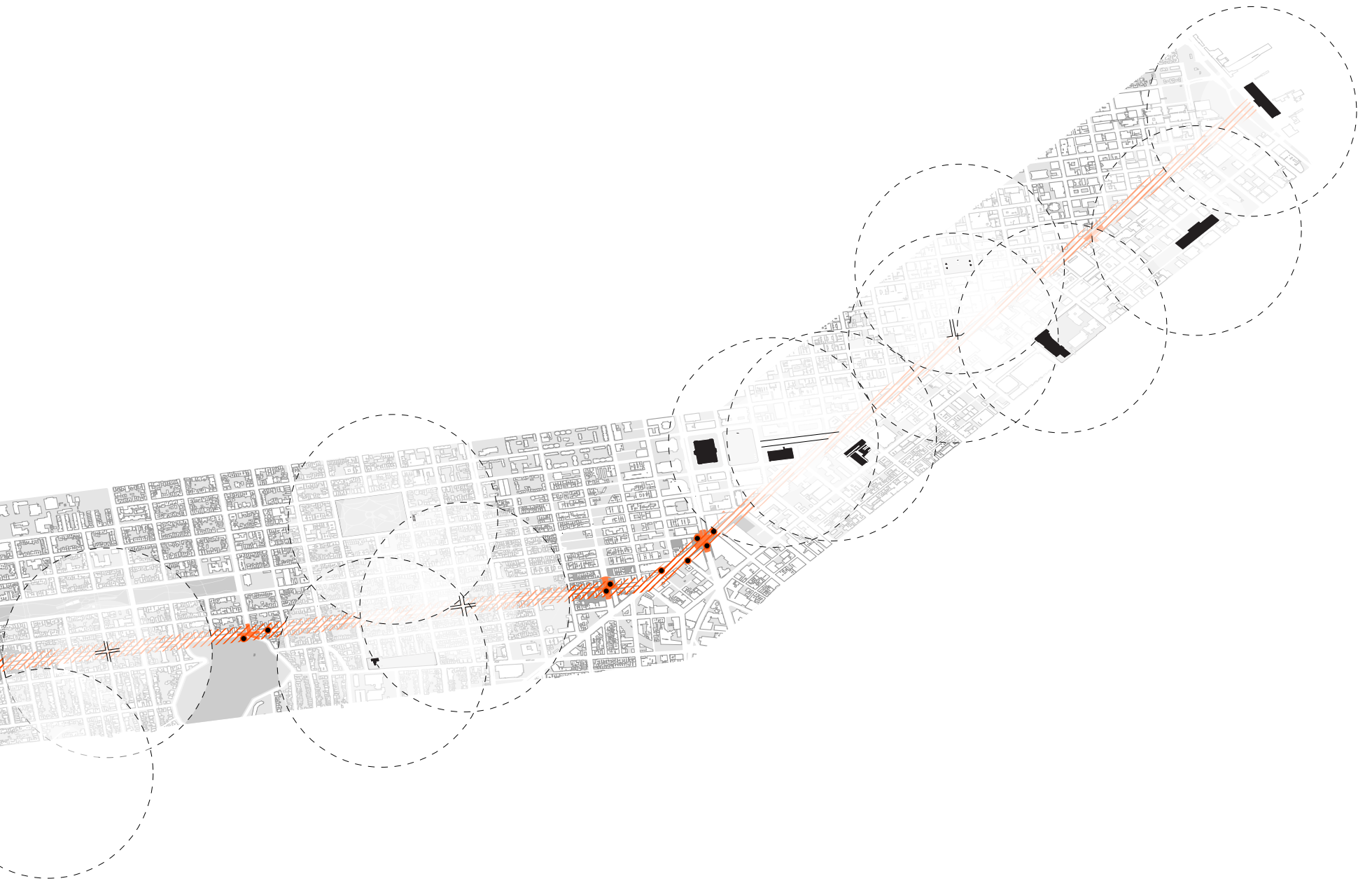


Figure 5.2: Plan of East-West Route Showing Interventions



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## APPENDIX A

### USING LAYAR TO CREATE AUGMENTED REALITY

The author used the Layar app to demonstrate the experience of true augmented reality during the thesis presentation. Photos of the views were printed on posters without augmentation, and the committee used tablets to scan the images, revealing the layers of augmented reality on top of the physical site. The users were able to flip through the four variations of augmentation for each site on the tablets. As this visualization was only temporarily hosted by Layar, an approximation of the images as seen through the tablets have been recreated on the following pages.



Download the free  
Layar App



Scan images  
with the Layar logo



Discover  
interactive content

Figure A.1: Layar App Instructions



Figure A.2: Wayfinding Overlay: Haight & Stanyan  
 Figure A.3: Wifi Overlay: Haight & Stanyan



Figure A.4: Historic Overlay: Haight & Stanyan  
Figure A.5: Social Media Overlay: Haight & Stanyan



Figure A.6: Wayfinding Overlay: Market & Van Ness  
 Figure A.7: Wifi Overlay: Market & Van Ness



Figure A.8: Future Overlay: Market & Van Ness  
Figure A.9: Social Media Overlay: Market & Van Ness

## APPENDIX B

### THE IMAGE OF WALKING IN THE CITY

The experience of walking was a key part of site analysis in this thesis. In *The View from the Road*, Appleyard, Lynch, and Myers use a series of diagrams (Figure B.1) to record the perception of movement along a highway. Abstract notations are used to analyze the image of the roadside landscape in relation to the passengers' changing position<sup>1</sup>.

These methods were adapted by the author of this thesis to analyze the pedestrian's experience of the site: the block of Haight Street between Stanyan and Shrader (Figure B.2). Similar notation methods were used to denote the desired physical attributes of street facades. The resulting diagrams focus on the perceived surroundings of the walker as they move along a path, not the actual locations of the surrounding objects. In this way, the diagrams study the effects of movement, not just space.

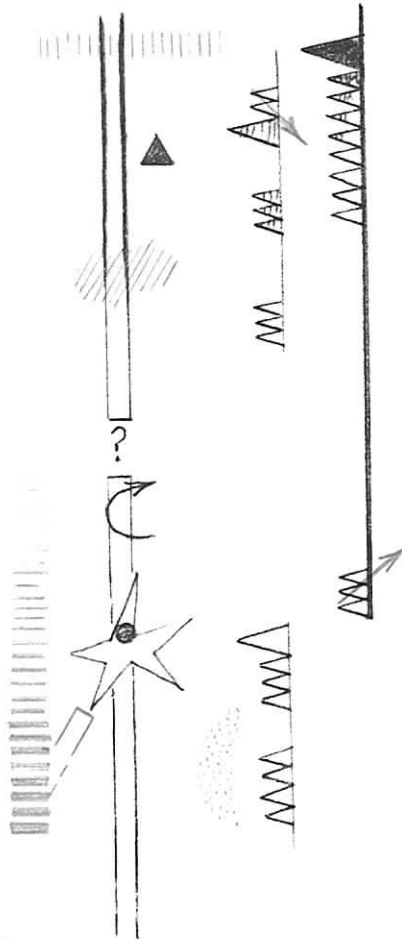
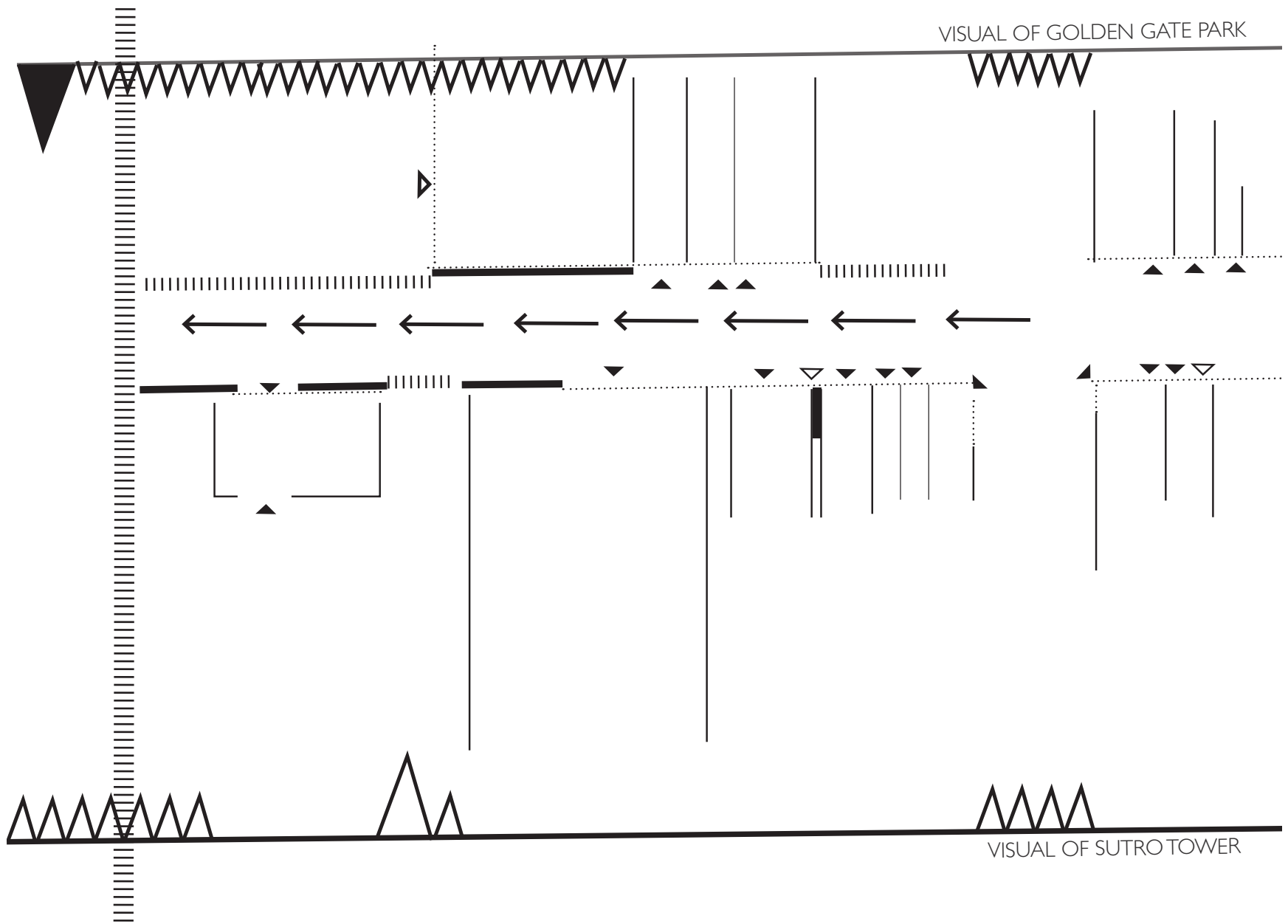


Figure B.1: Orientation Diagram (Appleyard, Lynch, and Myers)

Figure B.2: Adapted Diagram for Walking (opp.)

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<sup>1</sup> Donald Appleyard, Kevin Lynch, and John Myer, *The View from the Road*, (Cambridge: M.I.T. Press, 1964) 21.



## **APPENDIX C**

### **PATTERNS OF TECHNOLOGY AT HAIGHT AND OCTAVIA**

The patterns of technology were also diagrammed for a third site, at Haight Street and Octavia Street. The site was not incorporated into the final design for this thesis, but the resulting diagrams are reproduced on the following pages.

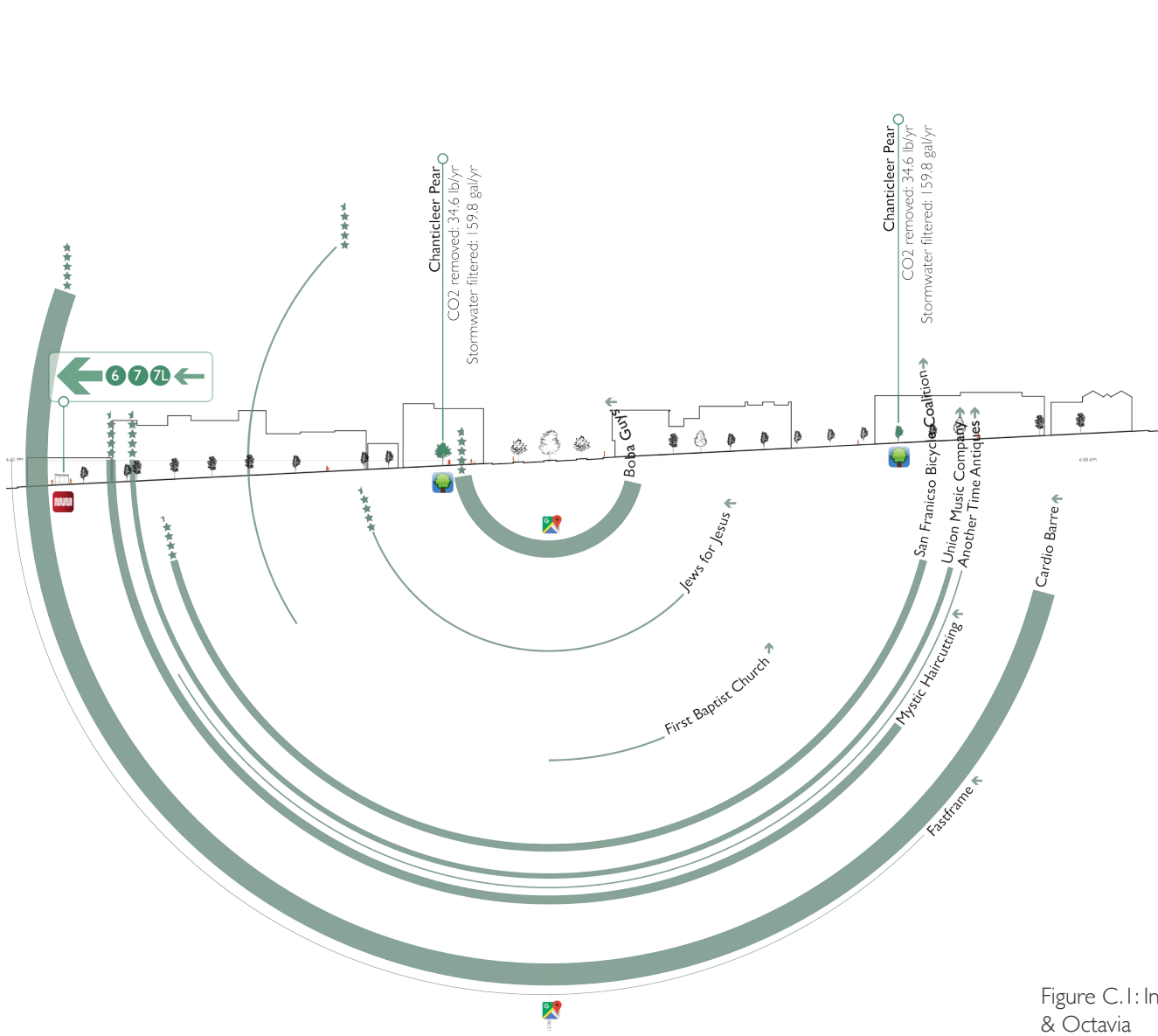


Figure C.1: Invisible & Informative Patterns: Haight & Octavia

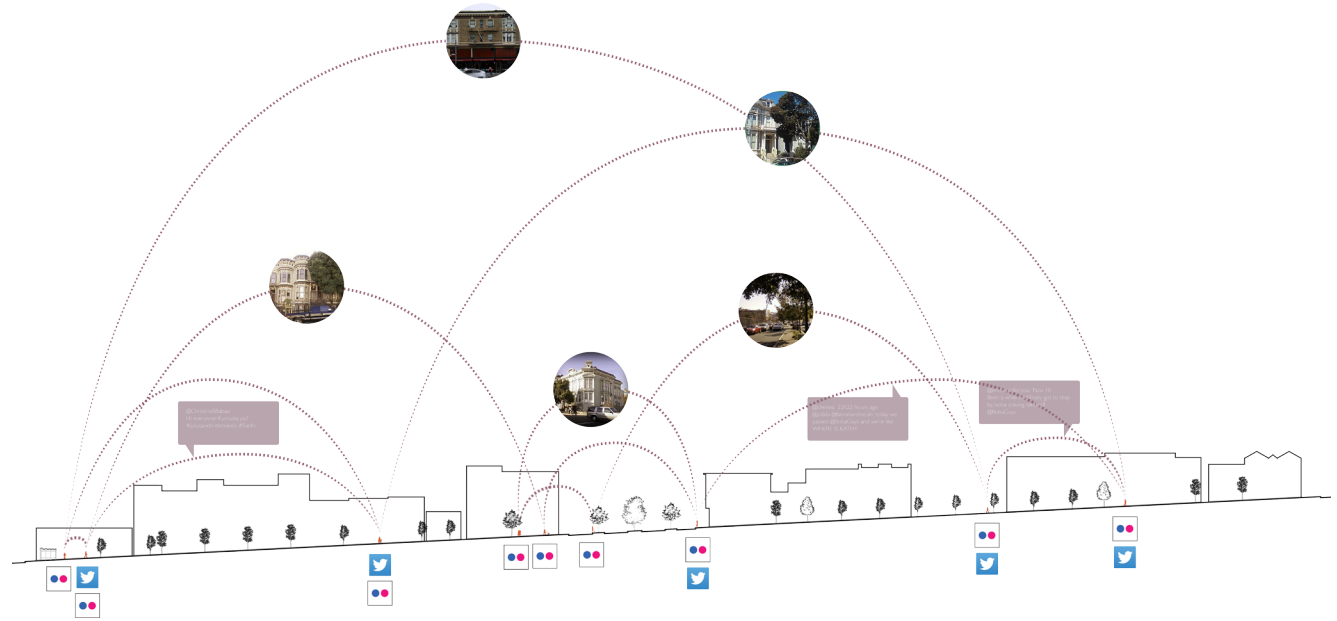


Figure C.2: Social Patterns: Haight & Octavia

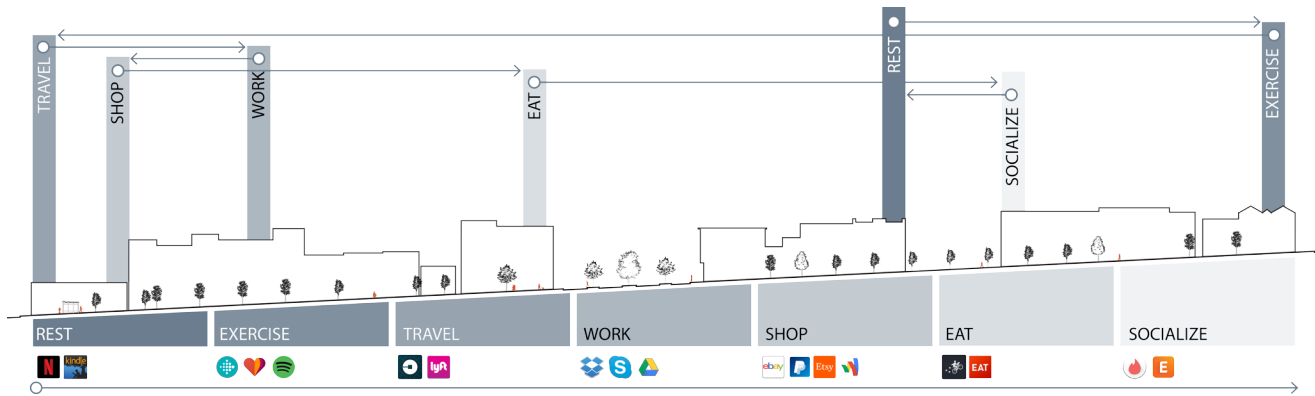


Figure C.3: Responsive, Shared, & Placeless Patterns: Haight & Octavia