Sonic Urban Transformations in Harvard Sq. During Covid-19

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ABSTRACT

The paper studies how the different phases of the pandemic along with the restrictions were affecting the walking experience over the period of three months. The paper proposes a computational model to understanding and representing the temporal changes in the urban experience through sound. A novel system of representation is constructed in the form of a notational system along with a interactive interface as a tool for encoding temporal changes into visual encodings enabling the comparison between different walking experiences.

Keywords: Urban Transformations, walking experience, soundscape, COVID-19.

1 INTRODUCTION

Cities are dynamically changing, complex environments, especially during unpredictable events like the global pandemic where parking lots and sidewalks evolve to become restaurants at certain times of the day. Yet, the current urban models and tools used by urban planners and designers include only static representations of the city, that rely solely on visual information such as maps and images. These static representations of the city are incapable of capturing, representing the changing condition of cities and changing urban experience. Thus, urban design and planning decisions remain insensitive to the social and spatial conditions that are in constant flux. As a result, they do not currently consider that the actual forms of urban spaces are ephemeral, temporal, and ambiguous in their nature and that they are best perceived in motion and through time.

The paper forms a first step in the development of a computational model to understanding and representing the temporal changes in the practiced space of the city, and in particular, the walking experience. Towards this direction, sound offers a more dynamic representation of everyday life in the city as it can convey information about the changes in the practices, actions, and events that take place in the space such as a sidewalk being converted into an outdoor sitting area or the lack of people in the streets because of lockdown during a pandemic. Moreover, sound can informs us about the changing rhythms in the cities that reflect the experience of the urban space in different periods of time, in different days, or different times of the day. These temporal changes in the practiced space constitute not only spatial transformations but also sonic transformations that shape the walking experience of a city. This paper argues that the coupling of visual and auditory information is crucial for mapping the changes in the walking experience as it correlates with space and time. How do the planning decisions affect the ways people experience the cities? How do we compare different experiences? How can we understand the different components that shape a walking experiences? How do we represent changes in the walking experience over time?

1.1 Case Study & Data Collection

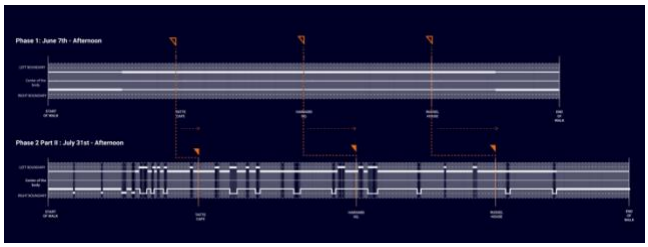
At the beginning of May 2020 Massachusetts announced their Re-Opening Plan including staged phases for the re-opening of local business and loosening of the restrictions due to COVID-19. Each phase contains a different set of guidelines and restrictions for local business, leading to different urban policies and transformations in the city. To study how the different phases of the pandemic changed the walking experience at street-level and the spatial conditions over time, a specific walking route around Harvard Square was used as a case study. The particular walking route was chosen by taking into consideration the type of businesses affected by the different phases. As phases evolved, spatial changes emerged, parking lots were converted to outdoor sitting areas for restaurants and bars, entrances to transaction spaces, windows and doors remained opened for better circulation, and people forming waiting lines on the sidewalks.

By collecting visual and audio data in the form of 360-video and 360-sound recordings, as well as geolocation data, captured over a three-month period in the afternoons and evenings, a more holistic approach in understanding change was developed. Furthermore, a comparative model is built to identify and compare the spatial and sonic transformations that shape the urban experience.

1.2 Representational System and Notation

A key component in this work is the development of a novel system of representation to enable the effective comparison between different urban walking experiences. D. Norman[Norman 1993] emphasizes the importance of representation to capture the essential elements of the events in the physical world. To represent these changes in a systematic way, a notational system was developed to encode these transformations into visual rules that will form the basis of a new formal approach to a multimodal representation of change. Furthermore, this representational system can be used enables the effective comparison between different phases, identify and predict changes in the walking experience and the practiced space of a city.

The walking experience notation has four main components, the time, the walking rhythm, the spatial and sonic transformations that affect the walk. Borrowing from the notation of music scores, the notation is split into three parts, the staff that contain the walking rhythm, the vertical lines like the bars, that correspond to specific places along the walk and the two horizontal lines that define the two boundaries of the sidewalk. The central horizontal line corresponds to the center of the body in regards to the walk. The boundary with the thicker line corresponds to the boundary between the sidewalk and the building while the less thick line, with the boundary between the sidewalk and the street.



1.3 Data Structure & Processing

Combining and processing the different data streams was particularly challenging. The data were structured based on walk represented by the geolocation information. Each walk contains around 350 GPS points with information about the duration/ walking pace and orientation. For each walk, the audio recording was segmented based on duration recorded in each data point. The analysis of the soundscape, follows two different approaches. The first approach uses quantitative methods to analyze the differences in the amplitude of the sound. In particular, dynamic tempo estimation and beat tracking analysis was performed using the python library librosa, to create the tempo of the soundscape and overlay it with the walking tempo. The second approach, follows uses semantic segmentation in order to retrieve information about the events and actions taking placing. The YAMNet deep neural network, trained on the AudioSet, was used for sound classification of the audio segments.

The result data structure: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      "speed": 1.595,
      "bearing": 196,
      "elevation": 14.56,
      "distance": 6.38,
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          "0": {
            "0": {
              "494": 0.0,
              "294": 0.07,
              "503": 0.05
              "analytic": {
        "change_tt": [
          7
        ],
        "change_t": [
          129
        ]
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  },
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      "lon": "42.371489",
      "name": "Blue Bottle Coffee",
      "status": "Closed",
      "bst": "0",
      "bb": "0",
      "bb_or": "L",
      "bst_or": "R"
    },
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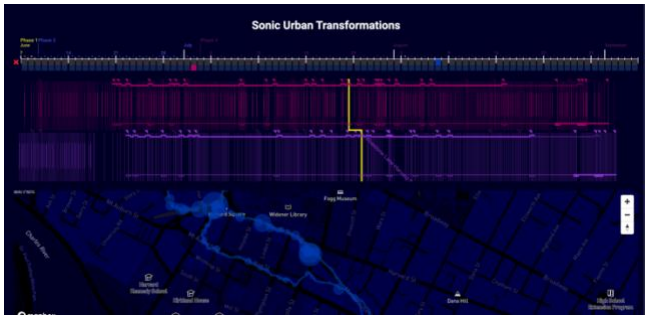
      -71.113187,
      42.370066
    ]
  }
```


1.4 Design Interface and Interactivity

The overall design of the website, was split in three parts, the timeline, the notation and the map. The timeline was customly design and it displays the amount of data recorded. On hover you can select between afternoon and evening recordings and click you can start loading different walks to compare. As the walks are loaded they are displayed dynamically on canvas. The scale of website allows only for up seven walks for comparison. Different color encodings correspond to different walks. A major challenge was to display the notation and the sound analysis, the change of the tempo together. The spacing of the lines indicate difference in the walking pace. To enable the effective comparison, a list of places as landmarks are drawn along the path. On hover on each place, a line like section is interconnecting the different walks. Each place is match to the corresponding place in the next walk. This design decision was very important in regards to the comparison of different walks since the walks are stretching based on the duration of each point.

Places – landmarks displayed on the notation, are having two corresponding statuses, open or closed encoded by the an empty or filled triangle. Those landmarks enable the effective comparison between different days.

The map displays always the latest walk, as reference to the geolocation of each point-line. Each point in the map is scale by the duration and when clicked it starts playing the sound. While playing the sound, the corresponding line in the notation is highlighted and it moves along with the sound track. While playing the sound, the two channels of audio are displaying the three top matched classifications of the sound from YAMNet, along with their respective probabilities. The change of tempo in the sound scape is displayed above the lines of the walk with a different stroke thickness to correlate the two different rhythms, the rhythm of walk and the rhythm in the soundscape.



1.5 Results

The visualization successfully allows for comparisons between different walks and when overlayed with the sound it reveal how they match and how the walking pace is shaping the sound, but also how the sound is affecting the walking pace. In addition it is interesting to see the trends of how the status of a place affects walking pace, but also the sound.

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