

# You'll Never Walk Alone: Designing a Location-Based Soundtrack

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## ABSTRACT

Musical soundtracks have great potential to enhance mobile walking experiences such as tours and guides, much as they already do for films and games. They also raise new challenges for composers as the music must fit a given landscape and respond to walkers' trajectories. We present a design for an interactive mobile soundtrack to accompany a visit to a sculpture park. We describe the motivating factors used to structure soundtrack and drive the compositional process.

## Keywords

Composing; music; mobile; exhibits; experiences; location; metaphor.

## 1. INTRODUCTION

Music plays a vital role in accompanying all manner of our experiences. Soundtracks within films, video games and ceremonies possess a unique ability to enhance a narrative, suggest emotional content and mark key transitions. Moreover, soundtracks often achieve all of this without being the primary focus; on the contrary, they typically assume a supporting role.

The proliferation of mobile devices increasingly leads us to listen to music while on the move. On the one hand, we create our own soundtracks by selecting music to accompany our everyday activities. On the other, musicians are seizing on locative technologies as a tool for creating new kinds of music that directly respond to people's movements through space.

In light of these trends, we consider the interesting question of how composers might set about creating musical soundtracks to accompany mobile experiences. Experiences such as guided walks, tours and even pervasive games could be enhanced by an appropriate soundtrack that adapts to a listener's journey through key points of interest. We recognize that the field of location based music is not a new one, and that prior work already demonstrates a wealth of creative approaches. However, the novelty of our work here is in the music serving as an *accompaniment* to enhance a location specific activity, much as a soundtrack does for a film. This calls for composers to take into account the key features of the experience, and its physical setting, to gently complement them through the music.

We examine this process from a composer's perspective by presenting an account of how they address the challenges of designing a mobile soundtrack for a visit to a public sculpture park. We expose key relationships between the raw materials of music (melody, harmony, timbre, rhythm and dynamics) and those of the physical setting, that enable the composer to gracefully mesh the music into the fabric of the space.

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## 2. RELATED WORK

We now present pertinent related work covering three areas.

### 2.1 Mobile Music

The advent of smart mobile technologies has led musicians and artists to explore the creative integration of music and place [7, 13]. Behrendt outlines four categories of mobile music: *sonifying mobility*, *sound platforms*, *musical instruments* and *placed sounds* [1]. Our focus is on *placed sounds*, denoting the attachment of sounds to locales, normally triggered by GPS. These experiences are typically non-linear, thus the music's arrangement is defined by a user's route and walking pace [1].

Some recent examples of work using *placed sounds* include Jorge Drexler's *'app songs'*, where individual layers of instrumentation are placed at different locales to be discovered via a listener's exploration of the space [10]. Music duo BlueBrain has released location-based albums for public spaces such as Central Park, in New York City and The National Mall Park, in Washington DC [5]. Here, musical extracts are placed onto a large collection of locales contained throughout these settings, such that entering them triggers new motifs and sequences that intertwine to create one extended listening experience [1, 5].

The key challenge addressed by our design is then: how does a composer know how to place sounds in a chosen setting and in relation to specific points of interest (e.g. sculptures)?

### 2.2 Film and Game Soundtracks

Musical soundtracks are a common feature in many films, television, video games and other narrative based performance work. Musical soundtracks can imply emotional content, represent characters and are often used to establish context, such as a historical period or location [3]. Two typical and general functions for soundtracks are *foreshadowing* and *accompaniment* [2]: *Foreshadowing*, finds the music pointing towards, or preparing the viewer for future events, such as the ubiquitous building of tension in a horror film just before the attacker jumps out. With *accompaniment*, the music is synchronized with a scene's visual narrative. Both of these key concepts are present in the design we describe below.

### 2.3 Music Theory and Cognition

Music theory and cognition can provide several key concepts to guide the composers of mobile soundtracks. The first of these is the notion of *musical arrival*. The overarching structure of a music composition can be viewed as a series of passages punctuated by moments of arrival [12]. Arrival, or closure, is typically formed from a combination of harmonic and rhythmic treatments. In particular, listeners learn to anticipate and expect common tonal resolutions at the end of compositions, or sections within [11]. Moments of closure can also function as a marker for the next section to come, and have been shown to support viewers' perception of narrative closure in films [17].

A second key area of theory concerns *image schemas*. Music is often discussed in terms of motion and spatiality: "The

*melody rises up*”, “*the tempo is fast*” and “*it starts on Ami, progresses through D Major to E7 and then returns to Ami*”. This linguistic use of spatiality has been discussed at length by music theorists, linguists and psychologists alike who have argued that, as physical beings, humans often best understand musical abstractions when they are rationalised into physical form and spatial placement [4, 6]. These *image schemas* lead to the formation of *conceptual metaphors* that enable embodied experiences. For example, the source domain (e.g. the spatial attribute = high, low) maps to the target domain (e.g. musical attribute = pitch), creating a metaphor (e.g. high pitch is up and low pitch is down) [16]. Common music related *image schemas* are the *container* (“*Music in the key of Bb*”); *source-path-goal* (melody & harmony); *verticality* (high, low), *force* (resolution of dissonance) and *balance* (tonality) [6, 16].

Prior work has demonstrated that motion and spatiality perceived within music can be transferred into the physical domain. Physical speed, distance and approach can be inferred by ‘intensity contours’ (i.e. crescendo, accelerando) whilst movement horizontally and vertically may be manifested in response to changes of pitch [6, 9]. In Hazzard et al.’s study of cross-domain metaphors in location-based music, participants were asked to follow compositions that presented adaptations of harmony, dynamics, melody and timbre as they walked around an empty space [9]. Their observations revealed that harmonic resolution conveyed a sense of arrival, while dynamic contours implied motion towards and away from a location. They also proposed three tiers of *attachment* between the music and physical space: *global attachment*, in which the continual, evolving presence of music can act as a container of the experience; *regional attachment*, in which a space is divided into smaller areas via variations in instrumental timbre and texture; *local attachment* in which musical accents signify key points of interest.

### 3. COMPOSITIONAL DESIGN

We now present a compositional design, drawing from the concepts presented above, used to develop a mobile soundtrack ‘app’ for a real-world setting – a public sculpture park.

The composer, an experienced musician, was also the principle researcher who documented their own process to produce a final ‘app’ that was ready for public deployment.

The design of our soundtrack also comprised of choosing a suitable real-world setting, a technical platform, a musical style and a technique for preparing musical media for our platform.

#### 3.1 Choosing the setting

We wanted to base our design in a setting that offered an established walking experience, of appropriate scale, which presented opportunities for pliant visitor exploration and engagement with many points of interest. The Yorkshire Sculpture Park (YSP), in the UK best matched our rationale. Spread over 500 acres, YSP is home to an extensive collection of contemporary artworks set in a diverse range of external spaces. We felt that the experience of discovering and contemplating exhibits while walking through parkland could benefit from an appropriately subtle musical accompaniment.

#### 3.2 Technical platform

We employed the *Calvium AppFurnace* platform to author our soundtrack and the associated *AppFurnace Player* to deliver it to smartphones. *AppFurnace* is a commercial platform and broadly typical of contemporary tools for authoring location-based experiences. It supports geo-location functionality. Circles and polygons can be drawn onto a map, which then function as GPS trigger zones for audio files. Multiple zones can be nested, overlapped or laid adjacent to each other. The

*AppFurnace Player*, when deployed uses a smart phone’s GPS sensor to track a walker’s movement in and out of these trigger zones. Figure 1 shows an example of nested, overlapped and adjacent zones from our soundtrack.

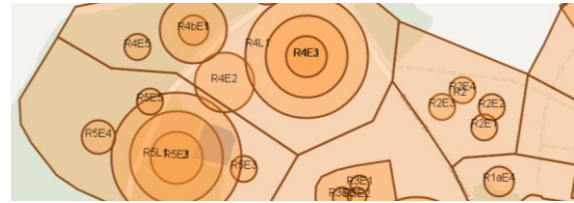


Figure 1: Example of zones authored with AppFurnace

#### 3.3 Musical style and preparation

Our intention was to explore methods of composition to suit the nature of the walking experience. So, we aimed to produce a subtle and contemplative soundtrack to appeal to a wide audience, rather than creating music to deliberately reflect the nature of the exhibits. We composed instrumental music in a ‘neutral’ style best described as the intersection between ambient electronica and classical, with largely slow tempi. To enable the dynamic control of individual musical elements, we applied *Horizontal Re-Sequencing* and *Vertical Orchestration* techniques for the music’s preparation and broadcast. These techniques are commonly used in video game soundtracks [12]. *Horizontal Re-Sequencing*, or cell-based music, refers to the application of short cells of prepared music, which can loop until the next cell is triggered. Cells permit flexible, real-time arrangement of the music’s structure and duration. *Vertical Orchestration*, or stem-based music, involves the vertical mixing of instrument layers, which can offer more complex and varied musical arrangements.

#### 3.4 Observation and initial design decisions

We made several early visits to the park to assess its suitability, observe visitors’ behaviors and map the location of exhibits.

A variety of visitor groups come to YSP, such as school classes, sunbathers and trekkers. We focused on observing those who visit YSP with the explicit purpose of viewing the exhibits. This group spanned a range of age and sociality (e.g. families or friends). The park contains a number of paths, which for the most part do not lead to and from exhibits, but rather offer walkways through the different areas of the park. The vast majority of the exhibits are situated on and surrounded by grassed areas. Exhibit viewers tended to walk routes across the grassed areas from exhibit to exhibit at a largely slow and unhurried pace. Typically, they would approach and touch the exhibits. Many would take photographs, mostly of group members posing next to the exhibits.

We chose to design the soundtrack for the area of the park that contained the main collection of exhibits, rather than wider areas of the park generally not explored by exhibit viewers. We mapped the location of exhibits in this area using a smartphone running a GPS tracking application. By walking from exhibit to exhibit and marking each of their locations with a ‘waypoint’ marker, a global exhibit map was formed. This process was repeated three times after which we averaged the GPS measurements. We followed this with an interleaved process of music composition and *AppFurnace* authoring, which resulted in an iterative development of the ‘app’ - progressively adding and refining the musical content and spatial functionality.

The completed soundtrack covered an area that contained 43 separate exhibits (an exhibit being one or a cluster of sculptures that form a single work by a single artist), using a 102 prepared music fragments (cells and stems) authored in *AppFurnace*, which was then deployed on an iPhone 4s for testing purposes.

### 3.5 Creating a landscape of musical regions

We strongly encourage the reader to examine the annotated zone map of YSP and accompanying video walk-through at <http://adrianhazzard.com/nime2014>.

We began by dissecting the designated area of the park into a set of 21 regions, which created a structural template for the soundtrack (see zone map). Each region formed a discrete musical episode, which when combined created the global soundtrack experience. Our observations of the park revealed some key features that suggested the appropriate placement, size and shape for these regions, which included existing physical boundaries such as hedges, trees, walls and buildings; diverse types of landscaping; clusters of exhibits; and areas dissected by paths. To render each region musically distinct the following three approaches were employed.

Within each region a different, but complementary, key centre (tonality) was used in the composition of the musical episode. Thus, when a walker transitions from one region to the next, a key centre modulation indicates the end of the current region and the start of the next. We typically used common modulations of 4th, 5th and relative 6th (to the relative minor, if the preceding key was major, and to the relative major if the preceding key was minor) (see zone map for key centre annotations). These inter-regional modulations draw on the concept of *closure* [15].

Inspired by the notion of *regional attachment*, each region used a distinct instrumental tone colour, formed via a different combination and balance of instrument sounds [9]. However, a balance was sought between maintaining uniformity across the global soundtrack, whilst making musical regions distinct, as there were too many regions to colour without repetition. Thus, some primary instrumental timbres featured across a number of regions, which were then augmented by additional timbres to form a unique local texture. Finally, the musical material composed for each region typically employed distinct themes, motifs or rhythmic ideas to create diverse musical episodes.

There were a small number of regions that did not contain any exhibits but needed to be walked through in order to reach other regions. To maintain the notion of *global attachment* [9] (the continuous broadcast of the soundtrack), a largely static musical episode with a low dynamic level was applied to all instances of uninhabited regions. These were considered ‘holding’ regions, there to preserve engagement whilst a walker was transitioning to the next ‘active’ region (see video 15:08 – 15:56 sec).



Figure 2: Associate-Regions

We noted that some adjacent regions shared mutual attributes, such as their landscaping or exhibits. These instances were treated as sets of associate-regions. For example, there was a collection of 13 similar sculptures from the same artist, which formed one collection. They were, however, distributed across two spaces distinct in their landscaping. Seven of the sculptures were placed on a formal walkway (Fig. 2, Region 1a), whereas the remainder were situated less formally in an adjacent grassed area (Fig. 2, Region 1b). We felt that the distinction between the two settings required different musical treatments, whilst the sculptures’ similarities necessitated a musical connection. In response, two variants of a single musical episode were composed, both utilizing the same key centre and basic

instrumentation (with some minor alterations). The discriminating factor was some variation and re-balancing of the musical themes (video 00:28 – 02:00 sec).

The paths within the park sometimes circled grassed areas containing the exhibits and on first glance appeared suited to define some of the region’s borders. However, if zone boundaries were placed along the line of these paths, visitors walking along them would be, in all likelihood, straddling the seams between zones, thus prompting undesired triggering between adjacent zones. In response, zone boundaries were authored to cross paths horizontally, or lie parallel to the paths, but set 5-10 metres on either side. In a similar vein, we were mindful that a walker’s route may ‘clip’ across the corners of zones, also instigating unwelcome triggers. While there is no universal fix for this eventuality, we applied cross-fades between musical cells to soften the impact of these occurrences.

### 3.6 Designing trajectories through exhibits

Key to our approach was to design a musical trajectory into and through each exhibit, as inspired by Fosh et al.’s research into designing experiential trajectories around artworks that were also situated in a sculpture garden [8]. We found our trajectory could similarly be divided into different stages, and we now discuss how these were actualized in our design (Fig. 3).

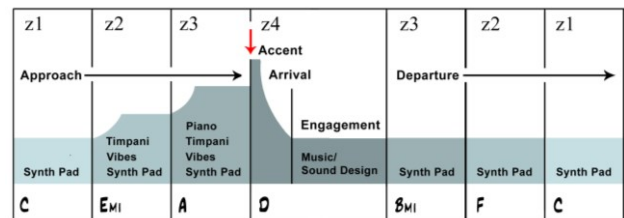


Figure 3: Trajectory through exhibit

#### 3.6.1 Approaches

As noted, visitors approaching and touching the exhibits characterized a significant behavioral attribute, one that we consequently addressed within the design of the soundtrack. Using foreshadowing [2], and the conceptual metaphor of *building intensity (crescendo) infers motion towards*, we applied the technique referred to as *approaches*: the intensification of the music as a walker advances towards an exhibit. This was authored via a set of nested zones, which surround and fan out from an exhibit (see zone map). Each zone triggered music of an increased intensity (whilst heading towards the exhibit). This intensification was realized via several musical procedures. One, for example, maintained the same underlying music throughout the region, but introduced a sustained string tone that ascended a step on each approach zone (*rising pitch infers motion towards* [6, 16]) (video 24:28 – 25:10sec). Another added a new instrumental stem and modulated the chord harmony on zone entry (video 21:27 – 25:35sec). A third combined multiple techniques, such as modulation of the chord harmonies, raising the upper note in each chord (voice leading) and adding new instrument layers to expand the rhythmic density (video 07:36 – 08:30sec) (Fig 3).

Many of the exhibits were too densely clustered to treat them all with *approaches* – they would have overlapped significantly and clashed musically (see zone map). Therefore, *approaches* were only applied to a selection of the exhibits. The number of approach zones authored around an exhibit ranged from one to four, depending on the available space.

#### 3.6.2 Arrivals

Different treatments of the arrival zone - the inner zone that contains an exhibit - were explored and applied. In contrast to



*approaches*, where a walker's advance towards an exhibit was foreshadowed, *arrivals* required the music to accompany the moment of arrival at the exhibit. Thus, we treated each arrival zone with a musical accent - a 'bell' like chime - as a signifier (Fig. 3). The impetus for this was taken from Hazzard et al.'s notion of *local attachment* [9], where an accented note in the music was perceived to signify a point of interest. We decided to compose one generic chime to sound at all arrival zones. The only variation employed was to the pitch of the chime. Twelve chimes, covering the twelve chromatic notes (western tonality) were created. So, each arrival zone, regardless of its underlying harmony had an appropriately pitched accent ascribed. Where regions contained multiple arrival zones, chimes of different pitches were assigned to each, using notes from the underlying tonality (i.e. Root, 3<sup>rd</sup> 5<sup>th</sup>). Accents of the same pitch were duplicated in some regions, but not for adjacent exhibits (video 06:28 – 07:35 sec).

For those exhibits treated with approach zones, the arrival zone also resolved the rising dynamic contour with a final intensification of its attributes (climax), before swiftly fading down to a lower dynamic level. This climax included a tonal resolution back to the tonic chord of the region's key centre, or a modulation to a new complimentary key (Fig 3). The reduced dynamic level and tonal resolution form musical closure [15].

### 3.6.3 Engagements

Hazzard et al. [9] noted that when music of a high dynamic level diminishes to a low dynamic level, many listeners perceived the music as having ended. We took motivation from this to compose *engagements* - the phase when visitors are observing an exhibit - that present a continuation of the low level of musical activity reached at the conclusion of the *arrival* climax (for those exhibits treated with *approaches*). If no approach zones preceded *arrival* then the underlying music either remained unchanged (video 06:28 - 07:35sec), or presented new themes with a lowered dynamic intensity (17:25 - 18:26sec), or had additional musical content introduced to provide variation (05:24 - 06:00sec).

### 3.6.4 Departures

When considering how to accompany a departure from an exhibit, the obvious process would be a reverse of the *approach* phase - the visitor withdraws from the exhibit and the soundtrack descends down the dynamic contour ascended during the *approach* phase. However, as the dynamic level was lowered during the *arrival* stage, a transition out from the arrival zone back into the final approach zone (Fig. 3, z4 & z3) would trigger a sudden and undesirable rise of the musical intensity. Thus, we aimed to maintain the same dynamic level presented at *arrival* zones upon departure from the exhibit (Fig. 3). This method necessitated the preparation of alternative music for *departures* than were used for *approaches*. This, in turn offered some creative options, such as variation to the chord progressions, themes, motifs or instrumentation used - allowing for a musical accompaniment on departure distinct from the foreshadowed one presented during the approach (video 07:36 – 09:00 sec).

### 3.6.5 Beginnings and Endings

When considering the beginning and ending of the soundtrack, we were mindful that users would be unaware of the location of their first zone of entry and last zone of exit. Therefore, we incorporated a manually operated introduction and coda sections. A *start* button on the app's UI initiates an introduction section, which would loop until the walker entered the first zone. An *end* button would trigger a coda section, which guides the soundtrack to a conclusion.

## 4. CONCLUSION

By presenting the design of this musical soundtrack for a visit to a sculpture park, we have offered some structural approaches for composers of mobile location-based soundtracks for real-world experiences. Future work will consist of evaluating the public's experience of this soundtrack experience. This will assist in the formation of recommendations for the composition of location based soundtracks, which can extend to other settings, activities and also other composers.

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## 6. REFERENCES

- Behrendt, F., The sound of locative media. *Convergence: The International Journal of Research into New Media Technologies* 18, no. 3, pp283-295, 2012.
- Boltz, M., Schulkind, M. & Kantra, S., Effects of background music on the remembering of filmed events. *Memory and Cognition* 19, pp593 – 606, 1991.
- Boltz, M., The cognitive processing of film and musical soundtracks. *Memory and Cognition* 32, (2004) 1194 – 205.
- Brower, C. A., Cognitive Theory of Musical Meaning. *Journal of Music Theory*, 44 (2), pp323–379, 2000.
- BlueBrain, <http://bluebrainmusic.blogspot.co.uk/search?updated-max=2012-01-02T09:27:00-08:00&max-results=7> [Accessed 12<sup>th</sup> August 2013].
- Eitan, Z. & Granot R. Y., How Music Moves: Musical Parameters and Listeners' Images of Motion. *Music Perception*, 23 (3), 221–247, 2006.
- Fencott, R., & Byran-Kinns, N., Sensory Threads: Sonifying imperceptible phenomena in the wild. In *Proc. of the 6th Sound and Music Computing Conference, 2009*.
- Fosh, L., Benford, S., Reeves, S., Koleva, B., Brundell, P., See me, feel me, touch me, hear me: trajectories and interpretation in a sculpture garden, *CHI 2013*, 2013.
- Hazzard, A., Benford, S. & Burnett, G., Walk this Way: Musically Guided Walking Experiences. *CHI 2014*, 2014.
- SmallWorldMusic. *The beat of the globe in the heart of Toronto: Jorge Drexler*. <http://smallworldmusic.com/artists/jorge-drexler/> [Accessed 25<sup>th</sup> January 2014].
- Meyer, L.B., *Emotion and Meaning in Music*. University of Chicago Press, 1956.
- Phillips W., *A Composer's Guide to Game Music*. The MIT Press, pp.188-201, 2014.
- Ratner, G., *The Musical Experience: Sound, Movement, and Arrival*. W. H. Freeman, 1983.
- Tanaka, A. & Gemeinboeck, P., Net\_Dérive: Conceiving and Producing a Locative Media Artwork. In Gerard Goggin, Larissa Hjorth (eds.) *Mobile Technologies: From Telecommunications to Media*. Routledge, 2008.
- Thompson, W.F., Russo, F.A., & Sinclair D., Effects of underscoring on the perception of closure in filmed events. *Psychomusicology*, 13(9), pp.9-27, 1994.
- Wilkie, K., Holland, S., & Mulholland, P., What can the language of music tell us about Music Interaction Design? *Computer Music Journal CMJ* 34(4), 2010.

## 7. APPENDIX

The soundtrack's zone map and accompanying video walk-through is available at <http://adrianhazzard.com/nime2014>