Location as Interaction: Exploring Blended Spaces in the Global Village

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Abstract. We present a novel means of experiencing an unfamiliar tourist destination using location-based interaction design with mobile devices. Tracking a visitor's location allows us to automatically present the visitor with relevant information as soon as they arrive at a point-of-interest. By synchronizing the delivery of digital content with the visitor's physical location, the visitor is able to move through and explore the physical and digital spaces simultaneously, using a location-based interface to experience a blended space. We theorize that this location-based content delivery method will instill a sense of freedom and immersion as the visitor explores the blended space in a natural and serendipitous way. To test our theory and validate our design strategy, we have developed a prototype application called Global Village Explorations.

Keywords; Tourism; mobile; blended spaces; user experience; location-aware; context aware.

1. Introduction

Worldwide tourism is an immense industry, with 980 million individual tourist visits occurring in 2011, an increase of 4.4% from 2010 [22]. However, even as the tourism industry grows, many public tourism venues in the United States are experiencing problems. Meetings with one of our stakeholders, Eastern National, have revealed that the current recession has led to budget cuts and reduced guest services in parks. However, there are many opportunities to supplement these lost resources through creating 'blended spaces' that incorporate a visitor's mobile device into the experience, allowing the physical space to be augmented with digital content [3].

The concept of a blended space is one where the physical and digital spaces are brought together in a carefully considered, harmonized way with the intention of delivering a superior user experience (UX). The concept leads to a design approach that foregrounds the correspondences between physical and digital space. For example the design strategy for blended spaces that we describe in this paper involves removing disruptive visual interaction in the digital space, to maintain an uninterrupted sense of the physical space whilst providing useful digital content.

In this paper we describe our experiences of developing a user experience at the Global Village at Rochester Institute of Technology (RIT). The design was influenced by the issues of developing location-based systems and by the concept of developing a blended space. After some background in section 2, we provide the design rationale for the experience and report on user reaction to the experience.

2. Background

Mobile devices provide the opportunity for tourists to have an experience that is tailored to their specific circumstances; their context. Context aware computing is concerned with knowing about the physical environment, the person, or persons using the device, the state of the computational environment, the activities being undertaken and the history of the human–computer–environment interaction [12]. A key feature of tourists' context is their location and providing location-based information or other experiences has proved a popular use of mobile devices delivering digital content. For example, HP labs in Bristol, UK developed an authoring package to help with the production of location-based experiences that was used on a

number of projects [18] (though the work seems to have stopped now). Detailed analysis was undertaken on one of these, Riot, that focuses on the UX of people experiencing audio content about the 19th century riots in Bristol at the location at which they took place [5]. Many location-based games have been developed and evaluated such as Cititag [21] where qualities such as immersion and presence have been measured [21]. Steve Benford and his colleagues have developed a set of constructs for describing their spectator interfaces [1], [2] and in particular have developed frameworks on people navigating the physical and digital spaces through 'hybrid trajectories' [21].

The central issue for location-based information is that people need to be made aware that there is some digital content nearby. They need to be guided to the location where it can be consumed. This is no trivial task. In some situations there may be lots of digital content related to a small space and perhaps of interest to different people. In other circumstances there may be only a few pieces of content, but spread over a very large area. If the tourist is walking, then the content can be delivered at one pace, whereas if the tourist is driving, delivering the appropriate content and the appropriate location can be very difficult indeed. Another issue concerns that size of the physical location where the content is relevant and how to control the content delivery if the person walks outside the area.

There are also issues related to the overall quality of the experience. If the content is delivered visually, there is the danger that tourists stare at their phones or tablets and do not appreciate the characteristics of the physical space. If it is delivered through audio, it may be difficult to share information with fellow tourists or members of a party of tourists. Interruptions to the flow of an experience may result in poor experiences and a lack of feeling of a sense of presence of other people or of the content itself.

Several previous studies have explored methods of reducing the necessity of digital interruption [10], [14], [19], [20]. The navigational aids in these studies refrain from using visual feedback to guide the user, which might constitute a disruptive transition of the user's attention between physical and digital spaces. Utilizing a non-visual method of accessing and presenting information may allow the design of blended spaces that successfully merge the physical and digital spaces into a cohesive user experience.

2.1 Designing with Blends

Fauconnier and Turner's book *The Way We Think* [9] introduced their ideas on a creative process that they called conceptual blending. These ideas were applied to analyze developments in HCI and software engineering by Imaz and Benyon [11]. They present an abstract design method that shows how conceptual blending can be used during the analysis phase of systems development to understand the issues of a particular situation and how they can be used during the design stage to produce and critique design solutions. For example, they discuss the existence of the trash can on the Windows desktop. Here the designers have chosen not to enforce one of the principles, the topology principle (which would suggest in this case that since trash cans normally go underneath a desk the trash can should not be on the desk top). Instead the designers have promoted the integration principle, keeping the main functions of the interface together in a 'desk top' metaphor. These principles of conceptual integration help to focus designers on the trade-offs they are making in designs.

In [4] Benyon brings the ideas of conceptual blending together with issues of place and presence to introduce the idea of blended spaces. He argues that both physical and digital space can be usefully conceptualized in terms of four key characteristics; the ontology of the spaces, the topology of the spaces, the dynamics or volatility of the spaces and the agency in the spaces. By understanding these characteristics and looking at the correspondences between the physical and the digital spaces, designers will produce new blended spaces that have emergent properties. People will not be in a physical space with some digital content bolted on. People will be present in a blended space and this will give rise to new experiences and new ways of engaging with the world.

The ideas of blended spaces were used to develop a location-based experience for visitors at the Global Village at RIT. The aim was to provide a novel UX for visitors that would allow them to explore the space and get information about the different parts of the space.

3. Designing with Blends in the Global Village

By reducing the visibility of technology, we hope to create a more immersive, blended space: a space that unifies the physical and digital spaces. Rather than including a method of navigation wherein the digital space offers constant navigational feedback, navigation assistance in the Global Village is silent for the majority of the experience. Visitors are free to explore the Global Village and approach whatever interests them, with minimal interference from the digital space. When the visitor enters the vicinity of a point of interest (POI, also known as a "hotspot") the mobile device notifies them that

additional information is available. In addition to POI notifications, we gently warn the visitor if they leave the area encompassed by the blended space: when they cross the digital "fence". We call this blended space implementation "fenced hotspots". Our design uses the visitor's position in the physical space as a life-size user interface, and the user's movement controls the information presented by the corresponding digital space. The synchronization between physical and digital is intended to be seamless, so that the visitor is simultaneously interacting with both spaces through their deliberate movement within the blended space.

Several other studies have developed mixed reality tourism experiences to help visitors navigate through an unfamiliar environment and retrieve contextual information about POIs. From audio and vibrotactile guidance [10], [20] to augmented reality (AR) [16] and interactive puzzles [6] to digital tour guides [15], different designs have been utilized to enhance the visitor's experience in mixed reality environments. Some designs focus on utility, such as offering navigational guidance for traveling between POIs whereas others generate dynamic paths and accompanying narratives based on POIs encountered along the way [17]. Still others avoid choosing a single path altogether, and instead give the user freedom to explore while still providing subtle feedback to help visitors stay on track [14].

Most applications offering AR guidance rely on the destination POI being within the camera's current field of view. However, Schinke et al. [16] have devised a novel method of showing off-screen POIs using a set of arrows rendered into the scene, and have compared this method to a non-AR approach using a minimap. They theorized that the AR design would show visitors nearby POIs in a more intuitive way, since less cognitive effort is required for the visitor to mentally map his position relative to the POIs being displayed. The experimental results lead the authors to conclude that their AR method of showing off-screen POIs was more effective than the minimap technique. An analysis of this comparison using blended theory would suggest that AR helps unify the physical and digital spaces, letting the user remain in the context of his surroundings while receiving information about nearby POIs. Benyon, Mival and Ayan [3] have used audio 'whispers' to guide people to the POIs in their system for 'Historical Echoes'. The whispers get louder the nearer to the POI the person comes.

Rocchi et al. [15] describe a system for helping a visitor explore a museum. As the visitor moves freely between exhibits, a virtual tour guide transfers seamlessly between mobile and installation displays to direct the visitor's attention and deliver information. The visitor is able to explore the museum in any way they choose and the mobile guide will follow them and provide information as they move between exhibits. Through the lens of blended spaces, we see that the physical and digital spaces remain highly synchronous; information from the digital space is automatically presented as the visitor's location changes.

Cabrera et al. [6] present an analysis of a mobile application that provides schoolchildren with interactive puzzles as they explore a museum. Visitors use information from museum exhibits to complete a series of challenges that involve rearranging images and text. Experimental results showed that participants became extremely focused on completing the digital puzzles, to the detriment of experiencing the exhibits themselves. Cabrera et al. note that visitors "used the exhibits ... as auxiliary material towards the main objective, i.e. solving the given [digital] problem" . From the perspective of blended spaces, we might say that the digital space drew visitors' attention away from the physical space, despite the explicit link between them. The physical space became simply a means to an end in the digital space because the relationship was unidirectional; the digital experience depended on information from the physical space, but the physical space had no connection back to the digital. A design that merges the two spaces in a bidirectional, symbiotic way might avoid this issue.

By analyzing these implementations of mixed reality through the lens of blended spaces, we hope to apply similar techniques in the creation of a blended space prototype. The next section introduces the prototype and gives insight into the design strategy behind our blended space.

4. Prototype: Global Village Explorations

The Global Village Explorations (GVE) prototype was created as a proof-of-concept prototype to test our approach to location-based interaction design. The physical space used in the prototype covers a small subsection of the RIT campus, the Global Village. The Global Village is a cluster of buildings surrounding an open quad approximately 9000 square meters in size. The area contains several buildings, shops, restaurants, and areas for eating and socializing, giving it a wealth of POIs for visitors to explore. The presence of buildings along three out of four sides also gives the area a natural sense of bounded space that is ideal for digital fencing.

GVE features RIT's mascot, Ritchie the Tiger, whose character delivers audio POI information. When GVE is started, a photo of the Global Village is shown next to a large button labeled "Start Exploring" (figure 1). When the visitor presses this button, an image of Ritchie the Tiger is shown, accompanied by Ritchie introducing himself. Ritchie tells the visitor that he will notify them when he has more information to share. The visitor can then put the phone in standby mode and keep it in

their pocket; the location tracking functionality has been started, and the visitor is free to start exploring the Global Village area.

4.1 Location-Based Interaction

Six POIs throughout the Global Village were chosen: the entrance, Innovation Center building, Global Plaza, ShopOne[2] gift shop, Market store, and Cantina & Grille. Hotspot sizes for these POIs vary from 10 meters to 20 meters in radius. When a hotspot is entered, the mobile device vibrates and plays Ritchie's roar to notify the visitor that Ritchie has information about the POI. Visitors can then take out their device and press the Play button to hear what Ritchie has to say. Ritchie's descriptions of the visitor's surroundings, i.e. information from the digital space, are played aloud to the visitor as they remain visually immersed in the physical space. After the visitor has finished listening to Ritchie's information, they can continue exploring.

Figure 1. The GVE application's start, exploration, and hotspot screens

The use of location-based interaction is intended to augment the user experience in three ways. First, the mobile device remains in the visitor's pocket as they explore, allowing the user to experience the destination without distraction. Second, the digital space only presents information relevant to the visitor's current location and uses sound for content delivery, minimizing the need to interact directly with the device. Third, the lack of navigational guidance means the visitor can move through the area however they wish. Navigational cues are given only when visitors cross the digital "fence" (figure 2). By encouraging serendipitous exploration, we believe visitors will have a more exciting and engaging experience.

4.2 Ritchie the Tiger

An important aspect of the blended experience is the narrator, Ritchie the Tiger, whose voice and character appear in the prototype. While he does not physically accompany the visitor during their exploration, his narration provides a link between the digital and physical spaces. Although Ritchie's presence in the physical space is limited to his roars, voice, and vibrations, the decision *not* to provide on-screen text of Ritchie's spoken dialogue was intended to reduce the visitor's perception of Ritchie as a purely digital character. Robert and Breazeal [13] show that children who interact with blended reality characters engage in play that is more imaginative and longer in duration. Their results suggest that blended characters are more engaging than those that are purely digital.

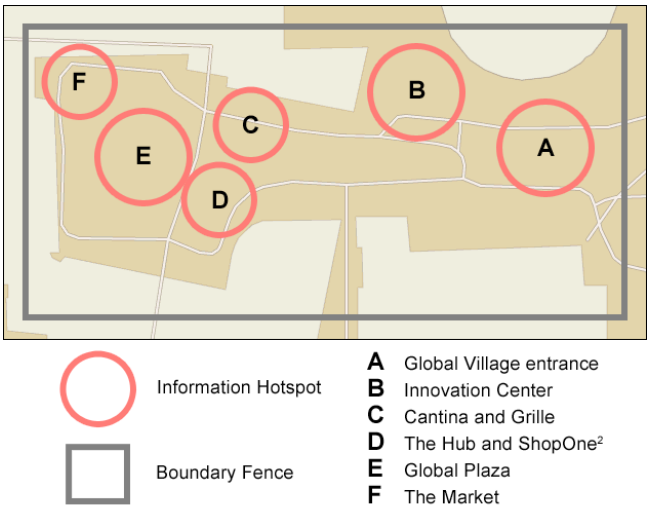

Figure 2. Global Village area with annotated information hotspots and boundary fence

4.3 Usability Testing

To begin validating the design strategy behind our prototype, we recruited ten groups of 2-4 participants for a usability test. Participants were high school students and their families visiting RIT as prospective applicants, which ensured that none of the participants had more than a passing familiarity with the Global Village area. Each group of participants was given a single Android mobile device with the GVE prototype installed and running. After giving each group a brief overview of the user interface (UI), they were led to the entrance of the Global Village. Participants were then told they were free to explore the area and interact with Ritchie as appropriate. While the participants explored, an experimenter shadowed the group to record relevant information.

Our preliminary usability test was intended to give our design team qualitative data regarding location-based interactions in a blended space. Our testing was not intended to be deeply rigorous; rather, its purpose was to provide a starting point from which to further develop our design strategy.

Our location-based interaction design was rated satisfactory by seven of ten groups who enjoyed the freedom of exploring the space. However, three of ten groups would have preferred more guidance; one participant remarked that it "felt like walking in the dark". Due to the natural sense of bounding in the space, the digital fence rarely came into play. Participants described Ritchie's information as interesting and concise, though some participants anticipated that every building would have informational content.

The combination of the tiger's roar and vibration effect that were used for notification was well received by eight of ten participant groups. However, some individuals were either unable to sense the notification or thought using both sound and vibration was redundant. Several participants suggested that the ability to configure notification settings could improve the experience by providing more personalization.

The amount of guidance had mixed reviews, but most participants suggested increasing it. Allowing the user to customize the level of guidance was a suggestion offered by several participants. Levels of guidance could range from GVE's hands-off style to explicit navigational assistance for guiding users directly to a chosen POI. A compromise between these two solutions might be a list of POIs. Unlike a map, a list could still minimize directional guidance, but would also enable users to review previously visited POIs and see which POIs they haven't yet visited.

4.4 Discussion

In reviewing participants' feedback, we find data that supports our design strategy, in addition to opportunities for improvement. While a majority of participants responded positively to the concept of non-guided exploration, a significant number expressed the desire for more guidance. One possible explanation is that participants value different things in a mobile experience. Not all tourists will sympathize with our goal of reducing interaction with their mobile devices; some may prefer to exert personal control over information access and navigational guidance. Another possibility is that participants'

motivations were not in line with those of our intended users. Our design targets tourists who are visiting a destination for the experience, while the participants in our study may not have had any base interest in visiting the Global Village.

Along with mixed feedback on guidance, participants provided a range of responses regarding the implementation of the Ritchie character. We believe that offering more customization options for delivery of digital content should please a wider spectrum of users. In addition, improving the quality of information offered by the character, along with the writing, voice acting, and other aspects of production, could make the character more useful and believable to users.

Conclusion

GVE represents an example of a genre of context-aware information systems for tourists and visitors. In this case the context is GPS location, but others such as [8] include other aspects of context such as personal preferences, previous places visited and so on. Location is a good aspect of context because it can be reliably measured with suitable accuracy. In the case of GVE the hot spots were 10m in diameter. However, others, for example [5], describe how frustrating it is for users who move in and out of a hot spot before they have had time to consume all the content relevant to that POI. Moreover it is not always easy for a user to go back to a GPS location. Unlike the physical world, where people can go back to a particular location, people cannot see GPS locations. Particularly in blended spaces where there is a lot of content this presents a real problem for the UX.

The blended spaces approach encourages designers to look at the correspondences between the physical and digital spaces (the ontology and topology of the spaces) and also the volatility and agency of the spaces. In the case of GVE there is not much volatility in the digital space; the content is designed to map onto specific physical locations. However, there is plenty of volatility in the physical space as other people are moving through the global village constantly. In terms of agency in the case of GVE we see the character of Ritchie as an important agent in the digital space. He helps to maintain the correspondences between the physical and digital spaces through providing a unifying narrative.

By focusing on the key characteristics of both the physical and the digital spaces, designers are sensitized to the mixed reality experience that they are developing. For too long designers have focused on the interface design and the interaction of a person with a device. With location-based experiences becoming increasingly common, design need to look at the user experience in a wider sense, encompassing physical location and movement, digital content and how to deliver that content in an engaging way.

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