

# 7 Stories: Location Based Story-Delivery System

MASTER DISSERTATION

**Mara Sofia Gomes Dionísio**

MASTER IN INFORMATICS ENGINEERING



UNIVERSIDADE da MADEIRA

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# Abstract

Location aware content-based experiences have a substantial tradition in HCI, several projects over the last two decades have explored the association of digital media to specific locations or objects. However, a large portion of the literature has little focus on the creative side of designing of the experience and on the iterative process of user evaluations. In this thesis we present two iterations in the design and evaluation of a location based story delivery system (LBSDS), inspired by local folklore and oral storytelling in Madeira. We started by testing an already existing location based story platform, PlaceWear, with short multimedia clips that recounted local traditions and folktales, to this experience we called iLand. An initial evaluation of iLand, was conducted; we shadowed users during the experience and then they responded to a questionnaire. By analyzing the evaluation results we uncovered several issues that informed the redesign of the system itself as well as part of the story content. The outcome of this re design was the 7Stories experience. In the new experience we performed the integration of visual markers in the interface and the framing of the fragmented story content through the literary technique of the narrator. This was done aiming to improving the connection of the audience to the physical context where the experience is delivered. The 7Stories experience was evaluated following a similar methodology to the iLand evaluation but the user's experience resulted considerably different; because of the same setting for the experience in both versions and the constancy of the most of the content across the two versions we were able to assess the specific effect of the new design and discuss its strengths and shortcomings. Although we did not run a formal and strict comparative test between the two evaluations, it is evident from the collected data how the specific design changes to our LBSDS influenced the user experience.

## Resumo

Experiências com base na localização e no seu conteúdo já têm alguma tradição no campo de HCI, vários projetos ao longo das duas últimas décadas têm explorado a associação de mídia digital a locais ou a objetos específicos. No entanto, uma grande parte da literatura tem pouco foco no lado criativo da concepção da experiência nos testes de utilizadores. Nesta tese, apresenta-se duas iterações de uma plataforma para a partilha de histórias com base na localização, inspirado pelos contos e narrativa oral da ilha da Madeira. Começou-se por utilizar uma plataforma já existente, PlaceWear, com breves vídeos produzidos por nós que recontam tradições e lendas locais, a esta experiência demos o nome de iLand. Efectuou-se uma avaliação inicial da experiência iLand, em que observou-se os utilizadores durante a experiência, em seguida estes responderam a um questionário. Os resultados desta avaliação informaram o redesenho da nova plataforma, bem como parte das histórias. Como resultado obteve-se a experiência 7Stories. Para atingir esta nova experiência foi realizada a integração de marcadores visuais na interface assim como uma reformulação de conteúdo utilizando um narrador para uniformizar as histórias apresentadas. Isto foi feito com o objetivo de melhorar a conexão do público com o lugar onde a experiência se desenvolve. A nova experiência 7Stories foi avaliada seguindo uma metodologia semelhante à primeira avaliação, no entanto os resultados reportados pelos utilizadores foram consideravelmente diferentes. A localização onde a experiência se desenrolou foi a mesma, bem como as histórias mostradas. Deste modo foi possível avaliar o efeito do redesenho por nós proposto para a nova plataforma. Apesar de não se ter efectuado um teste rigoroso de comparação entre as duas versões da experiência é evidente como as mudanças efectuadas influenciaram positivamente a experiência do utilizador.

## **Keywords**

Location-based Media; interactive narrative; GPS; visual markers; qualitative studies; cultural heritage; deployment.

## **Palavras-Chave**

Conteúdo Multimedia baseado na localização; Narrativas interactivas; GPS; Marcadores Visuais; Estudos Qualitativos; Heranca Cultural; Plaformas móveis

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# Chapter I. Introduction

## ***1. Mobile devices***

Mobile devices have become indispensable artifacts embedded in our lives: tools for supporting people's activities in their work as well as leisure time. They have evolved from portable one function devices (like phones, cameras, palm computers) to multipurpose ones, which led to the inclusion of a number of sensor technologies like GPS, compass, accelerometer, etc. These types of technologies afford more accessible ways of knowing the users position in space, therefore encouraging the development of location aware services. Furthermore, each new generation of devices is equipped with bigger and better screens and a general increase in performance.

Even in times of economic crisis the demand and uptake of mobile and smart phones devices keeps rising. Mobile phones are now being used by 91% of adults, according to the survey conducted in the USA between April 17 and May 19 of 2013 [1]. In this panorama mobile technologies offer us an opportunity to generate competitive services in particularly context aware and location based entertainment services.

In fact current mobile devices can be seen as a way to access information, but in a broader way, they can also be seen as a way to provide cultural and leisure experiences by enabling users to access and interact with a mixed reality universe that co-exists in the real world and where games and stories are embedded in the real space [2].

## ***2. Tourism and new needs***

Tourism is a growing industry and it continuously evolves according to the tourist's changing needs. In the past, tourists were satisfied with standardized package tours. Today, with the popularization of traveling, tourists are seeking for new tour experiences that are different from the past more adventurous and more authentic [7]. The new technologies have revolutionized the traditional model for tourism by allowing easy access to more and different type information about various tourism destinations. A new type of tourist has emerged, one that uses and relies upon

technology to have a more insightful experience in the place that he or she visits. This provides us with the opportunity of creating new engaging services for them.

Until today, there have been many efforts to use technology to improve the tourist's experience through mobile tour guide systems. While tourists choose to travel for many reasons, one significant market segment is that of tourists who wish to learn about the places they visit [7].

Most of these technological applications are information centered instead of experience centered such as GUIDE, an intelligent electronic tourist guide [8] and LoL@ an automatic tour guide system that offers multimedia information related to the sights of the city of Vienna [9].

Many of tourists want to learn about the places that they visit but there is an opportunity there to deliver compelling experiences that go beyond providing information about a place, a memorable experience that will attract and retain its users.

Based on this opportunity we are investigating how to help tourists (but not limited to them) have access to the most hidden information about a place's culture, expose them to the traditions and way of living of its inhabitants. We envisage doing this through a mobile story based experience.

### ***3. City as the place for play/ interaction***

A new city to its visitor or inhabitant “can be a strange and terrifying place”[3], there is definitely a risk involved in engaging in a completely new city. Trying to understand its rules without knowing them in advance, exploring neighborhoods and adventuring in its streets at odd times of the day or night. Nevertheless this is something that people often do when they travel to new cities. Because the city is a place for people to explore new possibilities in life, it's a place for self growth, where people can expand their horizons and minds in large part through interaction and encounters with others and with different cultures. Simmel (1950) mentions in his book [4] “interactive play in public places can help to build feelings of connectedness; it can draw heterogeneous people together”. Experiences embedded in an urban environment can reveal and wake new needs and possibilities in people, they can

stimulate and set new life goals. On the other hand the city can also be place for confusion and misinterpretations of its culture and people, because of “the difficulty of perception that comes from people lack of control over the way they encounter history and memory in the city”[3]. Moreover for an outsider the city may resemble to a labyrinth, with objects, monuments and spaces put together apparently without logic because outsiders to the city are faced with casual encounters and representations of the past and the future. These representations can be interpreted as they wish, according to their own past experiences, assumptions, and pre conceptions.

Cities are combinations of the past, present and future. Most cities are a mix of the old with the new. They are places filled with stories and memories that take us back to the past as well as forward, to imagine the future. As Gilloch (1996) highlights “urban images may gain new power and purpose, and may evoke and create history as present and future” [5]. So the city is not static, in the city there is always the possibility for more.

“Urban public spaces offer a richness of experiences and possibilities for action”[3]. Based on this statement, we will approach and study in what ways does the city offers opportunities for actions and play, in particular, through mobile location aware stories. We will build on how can the city influence and shape the design of such mobile location awareness experiences. Each city has its particularities with different purposes and meanings because of the different kinds of people and actions that take place there. These differences represent an opportunity for sharing and discovering different stories, cultures and meanings. We envisage the use of a mobile location aware experience to uncover and present these stories to a public of newcomers exploring the city.

People have the need to see, hear, touch, smell and taste. The city itself offers the rich and highlighting sensory experience. As Stevens puts it, in his book the “Ludic City”, “the city assaults all senses continuously awaking wide range of meanings and desires”[3]. Location aware stories system's can benefit from this intrinsic feature of the cities. Through mobile location aware narrative systems, the experience of the audience of watching a story evolves from being mainly an audiovisual experience to being an experience where all senses are stimulated. When watching a movie on TV

or in the movie theater people rely mainly on the visual and hearing senses but on a location awareness story system that uses the city as set, people would actually be capable of seeing, touching and smelling in the environment where the story is delivered to them as part of their experience. People's search for sensorial experiences and the way that the city offers them this, is an opportunity to combine this search for the sensorial and the use of real a location to deliver related story content, so that the story fruition is not just audiovisual but incorporates, the smells and the atmosphere of the surrounding site.

Each city has its particularities, which makes it different from any other for example the urban design. Each path, street, avenue, or bridge offers a different experience that depends of physical affordances such as the flow of people on that place, if it's a busy street or not, if it has traffic or if it offers protection from the weather. Some people can be more attracted to busy and modern streets, others with historic streets. In a city people choose to vary their experiences based on the feeling that the urban space transmits to them. The uniqueness of each city space is an element that can be used in the design of a location awareness system since we can address each story according to the streets where they fit the most. We can combine the urban design and the mood that it conveys with the atmosphere that we want to create when showing the stories.

The structure of an urban space and the way in which people move around it influences the experience and has the power to stimulate the possibility of chances, breakthroughs, diversity and risk. The simple act of walking has is a major factor of influence in changing the experience of a city explorer, like Gehl and Gemzoe (1996: 51) stated "walking is more than a form of transport walking also lets people stop change direction, and experience things" [6].

In this sense, walking in the city, works as another design element in the experience of using a location aware story system, since just by changing direction in a certain street it can lead to different stories and different ways of experiencing the whole narrative. We can design the system so that people don't have to change street or change direction very often and loose orientation. People could pursue all the stories in one line, and we don't have worry about keeping their direction under control.

Furthermore the city can function as a sort of labyrinth where people learn more about it and its culture by being immersed in it and walking its paths.

In summary, the city inspires in its inhabitants and visitors a sense of play and exploration because of people's movements and variety of perceptions within it. People in the city are constantly stimulated by a wide range of meanings and memories that may not be always consistent with their conventional expectations. A location aware story system can transform the experience of a person visiting a new place because of presenting him /her with the local culture in the form of stories can help them understand why that city and its inhabitants are the way they are, this background knowledge can also reduce the sense of alienation at times caused by being in a new city and bridge to our humanity as a common factor of all people walking the earth.

So if we consider the interaction between a user and a location awareness story system as a form of play and entertainment, taking advantage of the city attributes and its unique characteristics, we can then imagine design and produce a wide range of compelling and enhancing experiences emerging from the combination of both.

#### **4. LAMS**

“Location- Aware Multimedia Story (LAMS) systems, is a sub-genre within the wider field of locative media” [10] while locative media can be seen as the type of media in which the position and the change of positions within a particular space is essential to their conception. Nisi et al. in their work [10] defined LAMS as:

“Cinematically rendered narrative content related to specific locations and embedded in real spaces through the use of location aware mobile technologies. LAMS combine the mobility of the audience with the spatial distribution of the story contained in interactive, multi-threaded narrative experiences, to create a sense of place from otherwise unknown spaces.”

In the light of the above, we can define LAMS, as locative media where the type of media presented are stories strongly related to the locations in which they are presented.

In addition LAMS can also be considered as a “new genre of mobile location-based services, which uses peoples’ physical surroundings as a backdrop for storytelling as they move around an urban environment” [11]. It’s a new type of service where we move from the traditional guide system information and facts about a particular space close to the user are delivered. By listening/seeing a story the user may relate differently to the experience of the space, turning that space into something richer than just the physical urban layout of a neighborhood.

“Location-aware mobile narrative systems have significant potential when applied to urban spaces” [12]. They can emphasize the history and cultural background of a community for outsiders of that community and help to understand the lifestyle of the locals. For local people on the other hand, such experience can support and encourage them evoke their own roots and stories.

In our specific case the selected local stories are displayed as short video clips on a GPS and camera equipped mobile phone. The stories recounted in each video clip are the output of a process that involved several stages such as research, writing, designing and production, paying attention to use real space as a design element in the construction and production of the stories.

### ***5. Problems with LAMS / Motivations to conduct further research on this topic***

LAMS is becoming a popular field research in part due to the wide uptake and increased power of performance of mobile technologies and the increasingly rich experience that such type of systems can offer to the end user.

Designing a LAMS is a very challenging and complex process. It involves various disciplines from interaction and service design, storytelling to filmmaking, generally because combining an artistic with a technical work.

Some of the identified challenges in LAMS research and production are due to:

**The content:** The story design is a key aspect of successfully engaging an audience. The stories that presented through mobile devices to an audience on the move need to be engaging and meaning full in order to compete to capture the audience attention with all that is happening in the surrounding environment. LAMS need to be carefully

orchestrated and presented to the audience at designed moment and places so they won't result in overwhelming experiences when in combination with the surroundings where they are presented and other activities the audience member might have to engage in (like for example crossing a street, or watching out for obstacles on the pavement while walking and checking its mobile device at the same time) .

**The interaction:** A simple and intuitive interface design is required for this kind of applications, since we don't want users losing interest or focus on the story while trying to interact with the phone. Furthermore, the mobile audience has already to deal with many uncontrolled stimuli from the environment, so minimum disruption should come from the device itself and its interface to the stories.

**Technology:** The accuracy of some location aware technology may become a problem given that locations should be immediately recognized for the audience to have a more meaningful experience, and not losing focus while fiddling with the location sensors or delays in GPS fixes. Other problems may arise due to the brightness of the mobile phone screen during the day.

Throughout the work described in this thesis we will address the above mentioned challenges and propose a novel solution to overcome them.

## **6. Objectives**

The goal of this project is to develop a mobile location aware narrative system that overlaps narrative and space to provide a deeply compelling experience of Madeiran stories to locals as well as transient visitors to the island.

Starting from the iLand an experience that uses PlaceWear [13,14], a previously developed mobile story delivery platform with madeiran content, we would like to advance on the state of the art of mobile location aware storytelling then expand its capabilities by providing the system with new input features and sensing features as well as a new interface design. We propose the use of visual markers recognition to expand and improve the system capabilities as well as the audience experience when engaging with the story system.

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## Chapter II. Literature Review

In this section we present a review of related work in Location Aware Multimedia Stories. We will briefly summaries projects that we found relevant to our work and then discuss relevance and insights.

### **1. Location Based Narratives**

#### **1.1 Uncle Roy All Around You by Flintham, M. et al, [15]**

Uncle Roy All Around You (URAA) is a game from 2003 that mixes on-line with offline street players, who travel through the city in search of a fictional character called Uncle Roy. At the beginning of the game, street players are briefed and then sent out into the city to find a phantomatic character, called Uncle Roy. As they move through the city, they periodically declare their position using an electronic map and in return receive preprogrammed clues from Uncle Roy that lead them through a park and into the narrow city streets in search of his office. On-line players can find information in the 3D model that street players do not have, especially the location of Uncle Roy's office and can then engage the street players in an exchange of information in order to help them on their journey – or possibly to hinder them if they so wish.

URAA has been one of the first and most well published location based games design produced by Blast Theory art collective, and Mixed Reality Research Lab. Making use of the potential of locative media, players use the real world in order to unfold a narrative driven game. We like to acknowledge the pioneering work of this project and the inspirational value that affected locative media narrative and gaming in distributing action and narrative throughout real locations in a city, and combining an artistic approach to gaming and interaction design with cutting edge technologies and user studies.

#### **1.2 History Unwired by Michael Epstein, and Silvia Vergani [16]**

History Unwired (HU) is a project developed by Michael Epstein and Silvia Vergani in 2006, it delivers a walking tour through one of Venice's more hidden neighborhoods, through the prerecorded recounts of five local Venetians characters.

The experience is delivered over location-aware, multimedia phones and PDAs. The main goal of the project was to explore how audiovisual interactive media and the location sensing capabilities of portable devices can combine with rich visual landscape and street life of Venice creating a narrative that is both cinematic and physically immersive. Technically, HU content is made of a series of forty Multimedia files of one or two minutes long, running in a Motorola a1000 Smartphone as well as Dell Axim X50 Pocket PC's. The mobile devices are also programmed to interact through Bluetooth technology with two art pieces that can be encountered along the course of the users discovery journey. One of the most innovative features of this system is the presence of interactive content surprises (named Easter eggs, in game design jargon) along the tour. Such surprises function as rewards for the audience exploring the space (Figure 1). For example, when the most curious users explore an abandoned greenhouse they encounter a Bluetooth triggered thermocromatic painting of a rampant plant that lights up and slowly unfolds on the facade of the greenhouse. The HU experience was evaluated through surveys and users interviews, users appreciated the most the following features of the project: The content presented as narration and not as information; The presence of interactive surprises along the tour; The integration between real and virtual worlds, that enhances the possibility to understand interact with the real landscape and with local people



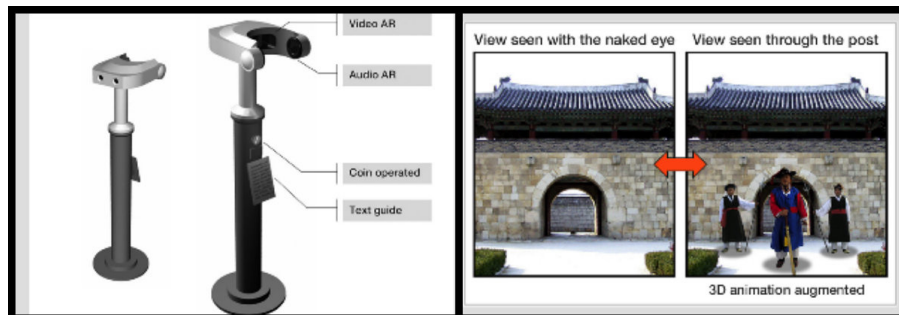
**Figure 1 - The Bluetooth activates an electronic circuit and the profile of the landscape appears on the clothes (Left); The interface: at any moment, visitor can look at the map and choose to listen one of the five characters (Right).**

From the HU project we learned that users particularly appreciate accounts of the local characters in the form of stories, how Easter Eggs are a powerful tool to reward the audience for their exploration efforts and how real location coupled with virtual

content is an appreciated experience for the audience. Nevertheless we note that at the time of the project mobile media was still limited in terms of location sensing capability as well as interface and interaction paradigms. This was due to the specifications of the mobile used at the time, where the screen size and resolution and even the location sensor is not as powerful as the one's that we have nowadays.

### ***1.3 Designing an Immersive Tour Experience System for Cultural Tour Sites by Doyun Park et al. [17]***

The Immersive Tour - IT project from 2006 was conceived to reflect the needs of tourists for meaningful and more immersive experiences while they are travelling. In the IT experience the tourists get to experience the historical scenes like for example a duel or a coronation scene that occurred at the tour site, as if they are travelling to the past. The authors achieve this by using audio and video AR technology to provide the immersive tour experience at the cultural site. The project delivers its content through a post, Figure 2, that stays fixed in one location and reproduces the vision and sounds of the historical event that occurred in the particular spot. For example the post will display a war scene by overlaying fighting soldiers of the past on to the actual surroundings and also provide the roars of the scene in surround sound. Moreover, the upper portion of the post can rotate side-to-side to provide a wide view of the scene. Through this system, the tourist will be able to experience and understand the historical event of the tour site in a more direct and lively manner rather than just by reading information on a panel.



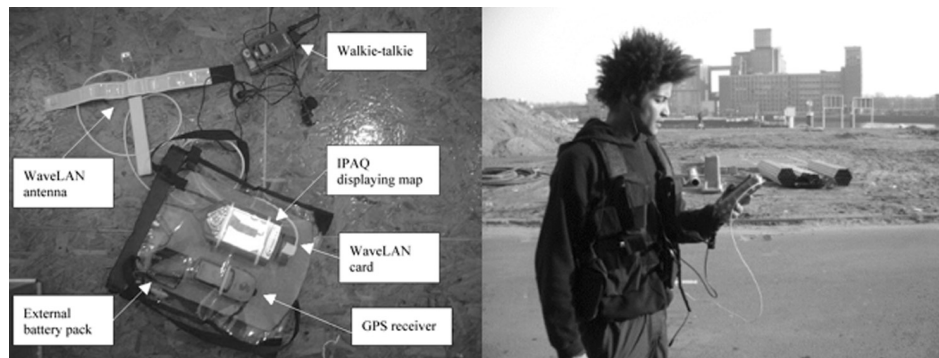
**Figure 2 - Concept image of an immersive tour post (Left) and Historical scene visible through the post (Right)**

As the project was evaluated on an actual tour site, the application proved to increase the interest level on the location as well as facilitate understanding of the content. So the potential of immersive tour experience in improving the quality of the tours was verified. From this project we confirmed the importance of overlaying real information on the location with where the fact or stories happen. Such practice has proven to increase the chance for the tourist of having a meaningful and immersive experience on their tour.

#### **1.4 Projects approaching seamless design by Steve Benford and Marek Bell**

##### **i Can you see me now? By Steve Benford et al. [18]**

**Can You See Me Now?** (2006) Is a mobile mixed reality game in which online players are chased through a virtual model of a city by ‘runners’ who are performers equipped with GPS and WiFi technologies (Figure 3) who have to run through the actual city streets in order to catch the players.



**Figure 3 - A runner's and the required equipment**

In this paper Benford et al. explains the diverse ways in which players experienced uncertainties inherent in GPS and WiFi, treating it as a designed feature of the game, and even occasionally exploiting it within gameplay.

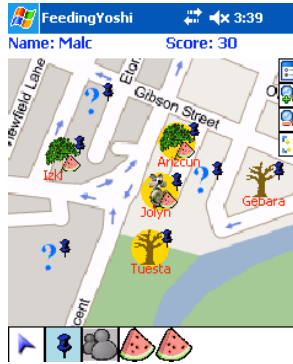
The author's argument is that “experience designers” should explicitly consider the different stages that the players can be going through: connected and tracked; connected but not tracked; tracked but not connected and neither connected nor tracked. Moreover they call the designers' attention to how a player might end up in

each of these states and what should be done about it. Some level of continued and meaningful experience for each state should be provided, rather than simply assuming that an error has occurred. Therefore the authors introduce five strategies that might be used to deal with uncertainty in these different states for different kinds of participants: remove uncertainty, hide uncertainty, manage uncertainty, reveal uncertainty and exploiting uncertainty. There is some earlier literature in the field that approaches this issue of dealing and taking advantage of the uncertain elements that is worth to mention. In *Seamful Interweaving: Heterogeneity in the Theory and Design of Interactive Systems* [19] the authors use an experiment with a mixed reality system to ground and detail their discussion of seamful design.

CYSMN shows how connectivity issues can affect the user experience in a location-based system and for us Benford et al. work is stimulating because we cannot let our users be affected in a negative way by this issue but instead we need to be inspired by them. Moreover in CYSMN the authors provide us with important tools. The states in which users can be in during an experience that we should be aware of when designing the experience and the strategies to deal with the uncertain issues that may arise in location-aware systems.

ii Interweaving mobile games with everyday life by Marek Bell et al [20]

In **Interweaving Mobile Games With Everyday Life** (IMGWEL) by Marek Bell et al. a follow up on the previous work, by Benford, we can observe that practical example of seamful design is provided. In the location-based game, *Feeding Yoshi – FY*, the key characteristics of its underlying technologies—the coverage and security characteristics of WiFi—are exposed as a core element of gameplay. The mechanics of FY is based on exploring the physical world to find Yoshis (creatures) and plantations, sowing seeds, harvesting fruit and feeding Yoshis (Figure 4).



**Figure 4 – FY screenshot showing Yoshis plantations (wireless networks) as icons.**

The seeds and plantations and the feeding places are depended on the wireless coverage, and players have to masters the wireless coverage in order to be successful in the game. We will not get into details of the game mechanics since for us what is interesting to mention is that this paper breaks ground in showing a new design approach in which the inherent limitations of technologies are deliberately exploited in a user experience, rather than being hidden away

### **1.5 ARCHIE by Kris Luyten et al. [21]**

ARCHIE, built and tested in 2008 is a handheld system designed to enhance the museum learning experience. ARCHIE focuses the role of social interaction as a prerequisite for intellectual, social, personal and cultural development. One of the main objectives of the ARCHIE project is to encourage interaction with the museum, the PDA and fellow visitors by creating a framework that takes into consideration these three interaction channels. Some of the first PDA-based applications for museums reviewed by the authors of ARCHIE, revealed some important shortcomings: the device demands lots of attention, tends to displace the surrounding objects and generates the unintended side effect to generate an individual, isolated experience (Proctor & Tellis, 2002; Vom Lehn & Heath, 2005; Vom Lehn, Heath & Hindmarsh, 2005; Angliss, 2006a, 2006b). These types of comments also emerged during the study of audio-tours experiences, which can be considered the predecessor of the PDA guided tours. Angliss (2006a) suggests “audio can also put individual visitors in a bubble, making it difficult for them to keep track of companions or

family members, let alone chat about what they have seen”. ARCHIE solution to tackle these issues was to develop a museum game; a collaborative learning activity for groups. Observations confirmed that the trading game fostered collaboration and lots of social interaction among its players. There was also a good balance between looking at the screen and looking around, the questions stimulated the students to look around and examine the museum objects.

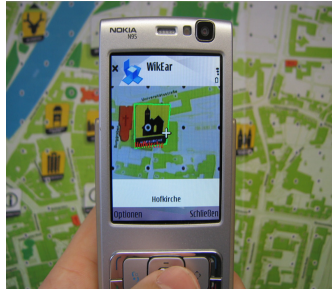
Nevertheless ARCHIE called our attention to the potential isolation factor in such experiences, and how the social aspect and connection with the surroundings are crucial aspects of the experience. In order to support and maintain a pleasurable feeling in the experience, when designing such systems attention needs to be put into not losing those aspects, by putting users “in a bubble”. Moreover the ARCHIE project highlights the importance of the game dimension of the experience, promoting interaction with the environment and eventually social exchange.

### ***1.6 Evaluating Automatically Generated Location-Based Stories for Tourists by Johannes Schöning et al. [22]***

Schoening et Al project from 2008, studies the tourist’s experience of mobile tour guide systems and highlights how the one key bottleneck in such location-based systems is the content development; existing systems either provide trivial information at a global scale or present quality narratives but at an extremely local scale. The primary reason for this dichotomy is that, although good narrative content is more educationally effective (and more entertaining) than a stream of simple, disconnected facts, it is time-intensive and expensive to develop. The WikEar system uses data mined from Wikipedia using data mining methodologies from narrative theory to produce high-quality narrative content for any location on Earth, this is done using a software called Minotour. This system generates custom, location-based "guided tours".

WikEar uses a magic lens-based interaction scheme, where basically the phone serves to show more information besides the one that is on the paper map, allowing the continued use of paper maps that have been shown to be particularly important in the tourist experience. The user can select a start and end location by sweeping the mobile

camera device over the map (Figure 5). The device is tracked relative to the paper map using tiny black dots printed on the maps. By leveraging the wide availability of large public city maps and the magic lens metaphor, WikEar avoids the costs of GPS and the interaction problems of small screen map.



**Figure 5 - Interaction with Wikear**

The authors conducted a semi-formal evaluation to assess the quality of the automatically generated stories but very few conclusions could be extracted because the results obtained had a very high standard deviation. This was due to the fact that the auto-generated stories were in an experimental form and when compared with traditional narrative they seem deficient to the users.

From this work we learned that content is of primary importance in the experience of location based tours, and meaningful content is expensive and difficult to produce. Low quality content can bias the tour and render the experience boring and un-engaging, on the other hand, in a research project it's rare to have the time and resources to produce high quality content. The content production is still an unresolved question for many projects in location aware content multimedia stories. Nevertheless the idea of delivering the content through a real map is interesting because people are already familiar with using maps and it's also a tangible artifact that people can easily relate to, they can bring it with them and share it afterwards.

### ***1.7 Location-Aware Multimedia Stories by Valentina Nisi, Ian Oakley, Mads Haahr[23]***

In this work of 2008 the authors present Location-Aware Multimedia Stories (LAMS) as cinematically rendered narrative content related to specific locations and embedded in those real spaces through the use of location aware mobile technologies. LAMS

combine the mobility of the audience with the spatial distribution of the story content in interactive, multi-threaded narrative experiences to create a synergy that this paper argues encourages the development of a sense of place from otherwise unknown spaces. The authors present design recommendations that can be directly applied to future, LAMS systems. These guidelines were deduced from a qualitative user study that was conducted with different audiences types. People from different background were selected (community users, non-residents, foreigners) to take the tour and then interviewed in order to determine if the system, Media Portrait of the Liberties (MPL), acted as a potential place enhancer, if the MPL could function as a story catalyst and finally to see if the system evoked immersive feelings for the user groups. The study revealed different effects on different kind of audiences, community members and locals perceived their place with added value and were inspired to remember more stories and anecdotes of their neighborhood; citizens but not part of the local community were quite immersed and enjoyed the experience most, while tourist would have liked more factual information and reported cognitive overload by having to navigate the place and take in the content at the same time. But all the audience members said that the system gave them a feel for the neighborhood suggesting that the system worked as a place enhancer. Our project is closely inspired by the MPL. The underlying assumptions, the goals, and the design recommendations made will serve us as a guide and will help us to see which issues we can tackle in our redesign of the system.

### ***1.8 Location-based Storytelling in the Urban Environment by Jeni Paay et all [24]***

In this work of 2008 the authors present their research into the design and user experience of mobile location-based services that use peoples' physical surroundings as a backdrop for storytelling as they move around an urban environment.

To explore the user experience of location-based fiction in the city they built a prototype system called "Who Killed Hanne Holmgaard?" This system was designed to operate in the city of Aalborg, in Northern Jutland in Denmark. The genre was an historical murder mystery set during World War II and situated in and around the

streets of Aalborg. The system was designed for computer supported collaborative play, in that two participants experienced the story by working cooperatively to unravel the mystery while on the move (Figure 6). Each participant plays a different character in the story, and these two characters must work together to solve the crime. The system simulates a location-based system, by using Wizard of Oz techniques to respond to the user's current location, and then the system provides the episodes of the storyline related to that location. The interactive story, accessed by using two networked PDAs, introduces to the two participants the characters they are playing and the other fictional characters in the story. The players are also introduced to episodic plot lines that interweave both fiction and fact, clues and logical puzzles that lead them through the story and through the city.



**Figure 6 – Illustrative images of the project “Who Killed Hanne Holmgaard?”**

From this project we learned the importance of coupling location clues of where the user is situated with a story element delivered through the mobile experience in order to create a fuzzy boundary between reality and fiction. Furthermore, from the audience point of view, the experience of the story as a pair can be exploited has information sharing and social values.

### ***1.9 ‘See Me, Feel Me, Touch Me, Hear Me’: by Fosh L. et al [25]***

In the project ‘See Me, Feel Me, Touch Me, Hear Me’ of 2013, the authors present the experience of visiting a sculpture garden where, the trajectory through each sculpture was accurately crafted. This project was conceived and developed to exemplify and test in practice some of the work on trajectories pioneered by Benford et al. [26]. The experience of ‘See Me, Feel Me, Touch Me, Hear Me’, combines text and audio instructions to drive directed viewing, movement and touching while the

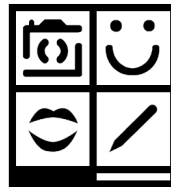
users can also listen to accompanying music. The authors designed key transitions along the way to oscillate between moments of social interaction and isolated personal engagement. Throughout their work the authors describe how designed experience is informed three types of trajectories: *canonical trajectories* which pass through key *transitions* including *beginnings*, *endings*, *role and interface transitions*, *access to physical resources*, *episodes*, and *seams* in the underlying infrastructure; *Participant trajectories* express what each participant actually does; *Historic trajectories* provide opportunities to reflect on and recount experiences.

This work is an example of how trajectories concepts are beneficial in designing a cultural experience. Moreover beneficial to designing our location-based experience is to plan, design and analyze how the three trajectories concepts presented can be addressed.

## **2. Markers Related Projects**

### **2.1 Telling a story on a Tag by Enrico Constaza, Mitja Leiness [27]**

In The Electronic Lens - TEL, a project from 2006, the authors focus on the design process for visual tags: TEL, highlights the importance of the graphic design of a tag for real world –applications. The idea behind this project is to use tags for an efficient and fast input method, allowing users to leave and retrieve digital information associated with physical objects or locations. These special types of markers, like we can see in Figure 7, were used in a real-world application - TEL. That is a social networking application where citizens could share information and opinions, related to a specific place in their city. The project provides for its audience a tangible experience of the physical environment and local communities enables users to create location based discussion and communities. Citizens can share information and opinions – which are related to a specific place in their city. This creates the opportunity to gain a new perception of the city, and encourages participation in civic decision-making process. The application can function as a guide, as a local storyteller and as a way to network people with the same interests.



**Figure 7 – dtouch markers used in ET**

This project brings attention to the use of visual signs to link digital media to specific locations. These markers enhance the user experience by adding a semantic layer of meanings, making the drawing of the marker a part of the experience. An important take away from this article is how to design the markers in order for the tags to be perceived as formal, authorized items, that add value to the objects they are placed on – rather than polluting the environment as ordinary stickers could be perceived as doing. Finally based on the authors' experience for the TEL project we learned important details about some functional aspects of tag recognition such as the material for the tags. Matte material should be used because of the camera recognition issues

with reflective surfaces. Also issues like water resistant, markers should be removable and easy to stick on rough textured surfaces, need to be taken into account.

## ***2.2 Collecting and Sharing Location-based Content on Mobile Phones in a Zoo Visitor Experience by Kenton O'hara et al. [28]***

In this project from 2007 the authors present a study of people engaged in a location-based experience at London zoo in which they use mobile camera phones to read 2D barcodes on signs at the animal enclosures in order to access related content. The system was deployed at London Zoo and signs were distributed at thirteen animal enclosures around the zoo each were approximately 20x30 cm and were situated at the viewing points of the enclosures. For larger enclosures with several viewpoints, multiple signs were placed to accommodate people coming from alternative directions. A mobile phone application - "Collect", was designed to let users retrieve content from data matrix code on signs and to review that collected content as they toured the zoo. For each situated marker/location there would be a mixture of audio, video and text files about the animals in that particular enclosure. Users could also choose to review any of the content that they had gathered. On opening up the collection of visual markers on their phones, the user would see the list of animals that has been encountered.

From this work is evident that using visual markers to bound content with a specific location is a successful strategy to engage people in collecting distributed location specific content and to ensure that the collector had actually been to the place or seen the real life counterpart of the collected item. This use of markers adds a tangible element to the experience of a LAMS and ensures that the participants reach and observe the physical elements of the desired location before consuming the content.

## ***2.3 Designing for meaningful visitor engagement at a living history museum by Luigina Ciolfi and Marc McLoughlin[29]***

QR codes have been used in a series of projects [30 ,31] to enhance visits to museums and art galleries. Tags can be added to the objects of the exhibits and then the visitors can learn more information about the objects by using their mobile phones. Ciolfi and

McLoughlin support meaningful visitor engagement at a particular heritage site through the use of QR code in the 2012 project: “Reminisce”. The visitors explore and immerse themselves in reconstructions of ways of life, people and activities from times past. The participants can enrich their visit to a series of buildings with a set of auditory digital “memories” narrated by fictional characters associated with the sites. The memories were represented by QR-markers that can be scanned with the phone: the markers were placed in different parts of a building, with up to four markers for one building (Figure 8). The QR codes then triggered an audio recording (by a voice actor) of the character’s memory at that site. Another important part of the visitor experience of the Folk Park is the presence of a team of animators impersonating costumed characters connected to the buildings.

The “Reminisce” system was available for trials for three full days during heritage site normal opening times. Although in a prototypical form, “Reminisce” was robust enough to allow full testing as part of regular visitor activities approximately one hundred people used the system. The evaluation data was collected through shadowing and semi-structured interviews. The findings from the qualitative study provided specific insights on what aspects of the museum are particularly memorable and engaging and could be further highlighted. The system worked well in fostering engagement with the heritage site. “Reminisce” provided a flexible frame within which the participants could access digital content and low-tech tangible artifacts to contextualize each building in the life of a realistic character. Moreover, the prototype encouraged the sharing of the participants’ own comments and recollections, thus marking their encounters in the site with personal significance. On the other hand the authors discovered that it was difficult for lone visitors to interact with the installation, since it was difficult for a single person to locate all the QR markers, carry all the tangible tokens, etc.



**Figure 8 - Visitors scanning a QR-Code (Left) and visitor listening to a memory (right)**

This project is an encouraging example of how to integrate visual markers and content that is related to a real location. We noted that in the evaluation discussion the authors report that although they had a team of animators impersonating costumed characters connected to the buildings, the visitors found it hard to connect the buildings and the real-life scenarios reenacted in front of their eyes. QR codes seemed a more effective way to revive the past in the audience's mind.

### ***3. Technical related work***

#### ***3.1 Designable Visual Markers by Enrico Costanza, Jeffrey Huang [32]***

In this project by Costanza and Huang a new approach to visual markers is presented. Visual markers are graphic symbols designed to be easily recognized by machines. By scanning a visual marker through a camera phone, users can retrieve localized information and access mobile services, very much like traditional QR code. The novelty of such system consists in making the markers semantically meaningful and giving the authors means to design them.

Currently QR markers themselves cannot be visually designed; they are not expressive to humans, and thus fail to convey information before being scanned. D-touch, is an open source system that allows users to create their own markers, and control their aesthetic qualities, by following some simple rules. The system runs in real-time on mobile phones and desktop computers. D-touch can enhance most applications normally supported by visual markers, including interactive guides, mobile service access, mobile games, interactive storytelling systems and augmented reality applications that have broad visual appeal and are not constrained to ugly

glyphs. The marker definition is based purely on topology and it leaves freedom for the geometry. A valid marker can be composed of a black region containing 3 or more white regions, and at least half of these white regions must contain one or more black regions. It makes exactly 3 levels of nesting (Figure 9) – it must be no more and no less. However, there is no limit in the number and the shape of the region [33]. Each marker is associated with a numerical ID, derived directly from its adjacency tree: this is a sequence of non-negative integer numbers representing the number of leaves contained in each of the branches, followed by the color of the root.







Marker			
Adjacency tree			
ID	1;1;1;4;black	1;1;3;5;black	1;2;4;6;black

Figure 9- Examples of d-touch markers fulfilling the constraints imposed by the system

We adopted the d-touch markers to enhance our story delivery mechanism, make it more accurate in the association of content with specific details of the site, as well as enriching the experience itself by adding an extra exploratory dimension to it, by asking our audiences to look for specific graphical signs in the surroundings. We integrated the d-touch mobile library developed by Costanza with our 7Stories application. Moreover the use of the d-touch analyzer software [34] was crucial in the design of our markers.

### **3.2 Cultural applications for mobile devices by Daphne Economou et al. [7]**

The aim of this paper is to identify a coherent set of requirements for mobile devices in order to allow the effective, efficient and economical development of cultural applications on PDAs and mobile phones. The authors build up their evaluation based on the current state-of-the-art authoring tools and on experience gained by using such tools in three case studies developed. The first two case studies focus on the use of handheld devices for the provision of interpretative cultural information in museum

environments, whilst the third is a mobile tourist guide for the city of Mytilene, Greece. Based on this review the author suggests authoring tool requirements for developing cultural applications on PDAs and mobile phones based on user and designer needs. Specifically it has been concluded that the choice of the appropriate technology depends on factors like the developers' technical background, the application requirements, the targeted devices and the project's timeline and budget.

In the scope of our project is valuable how this paper covers a wide range of related work on mobile devices and its use in tourism and also in authoring tools for the development of multimedia applications. For example GUIDE is a system that provides guidance, information and communication for tourists visiting Lancaster, UK through mobile devices [8]. The LoL@ (LOcal Location assistant) project [9] was designed to offer terminal positioning, incorporating an automatic tour guide diary system and the provision of multimedia information related to the sights of the city of Vienna. The REAL project was a hybrid (combination of client-server with application-based architecture) pedestrian navigation system, which helped the user to find information by generating a graphical route description [35].

Based on these examples the authors state that the choice of the type of architecture to use in implementing a tourist guide has a major effect on usability issues. Client-server architectures typically provide platform-independent services. However they raise many concerns, e.g. connection cost, roaming agreements, loss of network connectivity, etc. On the other hand, standalone applications do not pose network connectivity requirement, yet, they may be platform-dependent resulting in complications at the deployment stage for multi-device systems let alone the non-dynamic creation of content, which is offered to the user. Therefore we analyzed these pros and cons of both approaches and similar to the LAMS project previously described [14] we decided to make our system a standalone application in order to avoid delays in loading/downloading the video clips, and expenses in terms of data plans.

## **5. Reflection**

In the western world, with the exponential growth of smartphones capabilities and performances, as well as uptake, demands for new, entertaining and meaningful mobile applications are increasing there is a constant search for new and meaningful experiences delivered through mobile devices.

In order to fulfill this demand it is necessary to go beyond the standard application that present users with restaurants, hotels or services such as taxis or hospital on site and on demand. Information is everywhere and myriads of services are now available to make our lives more efficient, comfortable and safe.

Users are now asking for services, which are tailored to deliver experiences that make their lives richer, more meaningful, support their desires of explorations and entertainment. Our research fills this gap, where our users are looking for a moment to re-connect with themselves, with the past, with the experience of a place new or old, known or unknown combining guided exploration, engagement with the content and authenticity of the experience.

Through the related work described in this chapter we have seen that numerous projects have studied the link of digital media to specific locations or objects. A portion of the literature that we found has a technical focus [7,17] it reports systems, frameworks and architectures, generally supported by proof of concept implementations, with little or no emphasis on content production or user evaluation. Others report insights and guidelines from different and tentative evaluation strategies in order to capture the users' experiences and build guidelines for such systems [28,29]. All of the projects selected anyhow have a common goal, to guide the users through physical space in order to experience location related content, moreover they try to measure how we can design such content and such technologies in a way that yields meaningful experiences for our audiences or participants,

We identified through the study of these projects that in a location based experiences the content proved to be an essential key to provide a meaningful experience [22]. The users need to feel connected to the stories in order to find the experience meaningful, in order to achieve this a lot of effort and time needs to be spent in the story content research and production. Research projects often do not have budget for

content production and so sometimes small or distributed stories can become too superficial and users cannot connect or understand them. Furthermore, designing for the real world and not for a lab experiment or test is a very challenging endeavor many elements in the real world that cannot be controlled nor measured or reproduced. From the audience experience point of view, the complexity factor of such location awareness systems, that combine the real space with all its inputs and risks with rich media content can easily provoke a sense of being overwhelmed in the users. Furthermore, users can end up isolated from the surroundings [21], by paying too much attention to the device itself and not enough to what is going on around them. A balance between looking at the mobile phone screen and looking around needs to be found.

In conclusion, although the basis for location aware multimedia narrative are well set and underway, the potential and scope for research in this area is still wide and challenging. In order to progress and contribute to this exciting arena, we designed developed and evaluated a system which makes use of GPS and visual markers technology, location related and cinematically rendered story content to deliver a meaningful and engaging experience in the streets of a old historic city center.

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## Chapter III. Initial Research: iLand Experience

We decided to start our investigation by evaluating the iLand experience<sup>1</sup>. iLand uses PlaceWear [14], as story delivery platform. Then to populate the platform for the iLand story experience we gathered a number of stories that belong to Madeira Island and its people. After having produced the highest quality content possible, a user study was conducted to see how people respond to the application when presented in a real location. The conclusions taken from this study will inform the redesign of an improved location aware story delivery platform that address some of the issues highlighted previously in this thesis. Over the next chapter we will explain this initial steps in our research approach and its results.

### **1. Initial research**

Stories are all around us and belong to specific places, but sometimes can be hard to access to them, because of language barriers, because the people who have those stories to tell do not find the perfect opportunity to share them with others, or even more they do not find motivation or pleasure in sharing them with people they do not know. Our application would eventually bridge this gap, but firstly we had to find those stories. Our initial a research regarding the stories, legends and traditions from Funchal was conducted, through reading books and cultural magazines from the community archive. This was a key part of the process in order to learn the basics about Funchal's traditions and cultural background around the time we identified as the setting of our stories. We decided to place our narratives in the 50's. Madeira was still untouched by many of the changes that modified deeply its life and culture, such as the road system, and airport connection with the rest of the world. The 50's were also an easily replicable era in the costumes and location where to shoot the stories. The old part of town could have been still today a set for stories that happened in the

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<sup>1</sup> Mara Dionisio,Valentina Nisi and Jos P. Van Leeuwen. 2010. The iLand of Madeira location aware multimedia stories. Interactive Digital Storytelling (ICIDS'10)

Mara Dionisio, Valentina Nisi, Jos P. Van Leeuwen. 2011. iLand: a tangible location aware narrative experience. Tangible and Embedded Interaction (TEI 2011)

50's. Hence we realized that probably the best and more unusual stories of that time, we would still be able to gather them through word of mouth and talking to people who lived in those times in that area. This whole process of obtaining the stories needed to be very carefully handled because some people are more willing to share their stories than others, therefore sometimes it was necessary for us to start with a small story to trigger people's memories about their own stories. In this way the this initial research revealed to be a key aspect to trigger these personal stories.

The result of the stories collected yielded four main categories: Religious legends; Popular Legends; Traditions; Family Stories (Real Stories).

## ***2. Story Selection***

A selection of the seven stories that we were be able to produce was based on the potential drama of each story and the production feasibility (costumes, number of actors, location). We then started scripting and developing each story in terms of story structure, character, conflict and resolution.

For each story we finalized a thematic dichotomy, for example tradition, superstition and reality, good and evil, etc. And developed a world that enables the theme and the characters of the story to stand out and express themselves always keeping in mind the message we'd like the audience to walk away with. We intended the audience to look at the past but wonder if what they saw was true or not. We wanted our audience think about duality, real or unreal, fable or true story. And inside each story we'd like them to reflect how each character they encountered, is at the same time a hero and a victim, good and bad, superstitious and reality grounded. The world is made of shades of gray and the context in which characters operate and their history always results in a complex picture that shapes the actions and the ending of each story. By shaping the stories in this way we envisage the audience to connect with the characters, and the culture and traditions of the island, as well as with its real people and community. But we could not advance more in the stories with out defining how and where they would be presented.

### **3. *iLand Experience***

Once the stories had been chosen we focused on how to design the whole experience. We decided what audience to target, how to produce the stories, in which location the experience should take place and the mobile interactive platform to use to deliver the stories.

Audience: For this initial research we decided to focus on a broad sample of users, around the same age range, but with different backgrounds and experience with the city.

Content: Selection of stories made is related to traditions and folklore of Funchal with a special focus on strong characters, stories that portray the religious background of Madeira culture and contrasts with the some supernatural and mystical beliefs. Here are the types of stories selected:

- Witches Stories (3 interrelated stories, in order to test how would a sequential narrative work in this location based format)
- Milkman Stories (2 related stories)
- Santo Antonio Stories (2 stories)

Location: To give a contained experience in a traditional setting easy to navigate by non-local people, the location chosen was Rua Santa Maria in downtown Funchal. This particular street was chosen to deploy the LAMS system due to its particular and remarkable attributes since it's located in the old part of town it has a sort of mystical and traditional aura, which fits topic of traditional stories and the type of experience that we want the audience to have. Also it has a straight and easy topography, in this way people won't feel overloaded with the orientation problems of being in a new place and can appreciate the features of the old part of town from a representative street.

Platform: PlaceWear[14] is a application with a map interface that allows the presentation of multimedia videos. The system is implemented on a smartphone that has GPS integrated; all the system features were kept unchanged. The stories are placed in the map marked by small dots, also the user position in the map is signaled and the phone vibrates when the user is near a story. Then the user has the option of watching or not the story.

#### ***4. Refinement and Production of the stories***

After a clear plan defined on how we would test experience more effort needed to be put in the refinement of the stories. At this stage some books [37] provided the necessary background for story writing and character's construction. First we started by building up the characters of each of the stories like for example the character of the young witch. On one hand she is just an innocent girl, cursed by a witch, but then she falls in love with a man that is not available, and uses her witch powers to seduce him. Most of our characters have a twist about them; in this way we ensure a character arch within each story fragment and keep the dramatic arc and emotional involvement of the audience. The stories were adapted for the small screen the adaptation also emphasized links between the different stories, yet without distorting their original nature.

Three of the stories are about witches: the audience follows the story of a witch from the moment when magic powers are passed to her (Witches 1: Passing the Power), to when she finds out that she is a witch (Witches 2: Open Scissor) to when she finally uses her powers in the name of love (Witches 3: The Cross). Two other stories, named: Milkman 1: Spilled Milk and “Milkman 2: Stolen Cans,” focus on a fictional milkman character but based on real stories told to us. In these stories users can find out about the daily routines of the milkman and his soon that helps him and what happens when these daily routines are disrupted. Finally, two stories center on superstition around the Figure of Santo Antonio: the first one illustrates how the statue of Santo Antonio helped a girl to find a husband, and the other how the saint can help girls to find out who are they going to marry.

After structuring and developing the stories, their characters and the sequence of events (plotting the story) we proceeded to the production of the multimedia narratives [38].

The video production was carried out with amateur actors and took approximately 6 weeks to complete, including the final editing (See Figure 10 for screenshots) . Some of the stories have stronger links with the locations; in particular the footage for the two milkman stories is filmed on the very location where the stories are displayed. The other stories, due to difficulties in accessing interiors of local buildings, had to be

shoot using other available locations. Attention was paid to the fact that the visuals had to work by inviting the user to make connection with the actual real place, in Rua Santa Maria, where the story is delivered to its audience. For example, the Santo Antonio statue that is thrown from a balcony uses an indoor setting for the video shooting, but a real balcony in the Street of Santa Maria as a reference in the setting where the audience sees the story.



Figure 10 - Screenshots from some of the stories

## ***5. Pilot User Study***

A small-scale trial involving 5 participants was conducted as an initial evaluation of the iLand experience. The five participants were recruited from the University of Madeira and were individually asked to try out the system (Figure 11) on site. The study took place in November 2009, it is worth highlighting that at this time pedestrian navigation on smartphones was not yet very common in the context where we run the study.

Data was collected through a mix of qualitative techniques. Participants were asked to answer a questionnaire at the beginning to collect general information such as age, gender, and occupation to see how familiar they were with technology, with the city of Funchal and more in general with the surrounding region. Then a 5-minute explanation of how to use the system was provided by the experimenter, after which each participant started the tour. The participants were shadowed during their experience with the system, the interaction lasted approximately 45 minutes. At the end semi structured interviews were conducted to explore how users generally felt

about a system of this kind, their thoughts about the content and what problems did they encounter. The interviews lasted approximately 15 minutes. Notes were taken both during the shadowing and the interviews (with the aid of audio-recording); these were later coded through open codes, and then grouped in categories.

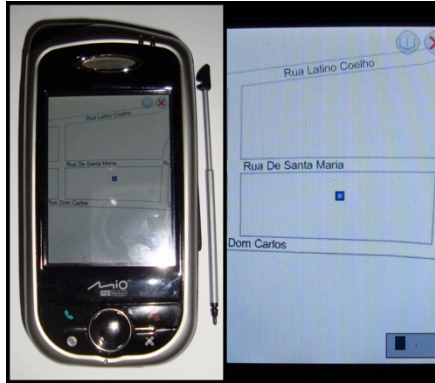


Figure 11 - PlaceWear hardware platform and interface, used in the user study

## 5.1 Evaluation Results

From the analysis of the observations and interviews some patterns emerged very clearly and prompted us to redesign the system, as is described in the succeeding chapters. The following paragraphs summarize the patterns that we observed.

### i Engagement

We observed that all five participants engaged with the system and the content. They told us that they liked the system, and that they enjoyed the stories because through them could learn more about the local traditions. This emphasis on content suggests that the system worked well enough, and allowed them to experience the stories although some user's mention a lack of context of the stories presented, for example Jota a 22 year old student of software engineering, living in Funchal perceived them as being random stories. This is also closely related to what will approach in the next topic about orientation issues related to linking the story to the location.

Participants reported that they found the system generally easy to use, except for some specific usability glitches (e.g. the dots indicating the stories on the map being too small), and for the malfunction of the GPS, as we discussed next.

## ii Location Sensing and Orientation Issues

Participants were enthusiastic about the idea of the system automatically following them, and they liked very much the prompt of the vibration. Ken, a 31 years old researcher with a background in design and HCI, visiting Funchal for about one month had already experience with GPS and location-based systems, described the experience of finding otherwise invisible stories along the road through the device as “*bumping into stories*”. Leo, a 24 years old student in electronics engineering, who does not live in Funchal, but in a nearby village, had little experience with GPS only used it for car navigation and had no experience with location-based systems, told us that for him the best thing about the system was the fact that it vibrates when there’s a story nearby, providing a feeling that the system is “*following and being there with you.*” However, it became quickly evident that the technical limitations of the technology had a strong negative effect on the user experience. GPS simply did not work well in the location where the system was deployed, so more than half of the location triggers were missed. This was in part due to the fact that the system was quite slow in obtaining a fix and often participants walked past the stories hotspots. Such technical limitations are probably due to the narrow nature of the street and the shadows from buildings, as suggested by prior work [39].

Orientation was also a more general problem for our participants. Even when GPS triggered the stories correctly, participants looked around themselves, as trying to relate the content of the video clips to the physical space they were in, seeking some sort of clues indicating that they were in the right place for the current story. They often appeared confused and unsuccessful in this. Moreover, in many cases it seems that participants were not sure about what direction to follow after viewing the clip, and in some cases they asked the experimenter for instructions. Another issue worth to mention is the traffic in Rua Santa Maria, sometimes users stopped in the middle of the street to watch the story, occasionally there were some cars passing which can potentially disrupted the experience. Although none of the users mention this as being a problem we observed this situation and experience problems could arise from this.

### iii Physical Landmarks and (Unfulfilled) Expectations

Two of the participants had strong and specific expectations that the stories would be present near physical landmarks. Some places seem to naturally suggest a sense that there is a story attached to them. For example, when Ken reached a place with a small course of water he stopped to wait: he felt there was supposed to be some story there even though the phone did not vibrate. Another participant, Vanessa, a 28 year old student in Mathematics who grew up and lives in Funchal, is very familiar with Rua Santa Maria, who did not have a direct experience with GPS and location-based systems, stopped to wait several times throughout the experience near some historical landmarks such as a museum and a chapel which are situated along Rua Santa Maria, expecting to have some stories connected to them. It is worth emphasizing that these location-based expectations emerged for both a visitor and a local user.

### iv Screen Capturing Attention

We observed that participants have often focused their attention on the device, trying to find their way around to the stories using the map. This, too, was a reaction to the malfunctioning of the GPS: for example, when Vanessa realized the device was not tracking her position, she said, *“oh it’s not working; now I have to pay attention to the map.”* She then walked back towards the beginning of Rua Santa Maria and from this point on the moment she focused much more on the device and less on the surroundings, partially defeating the point of our location-based experience.

## **6. Proposed solutions**

In this section we're going to address how we intend to solve the problems found in the user study. In relation to the story related problems, the lack of context was one of the priorities to be handled so we decided to create a narrator that is going to present each of story and make the user understand why he is seeing that specific story. Moreover the users mention that is hard to focus on the stories while looking at the surroundings so we decided that to give some time to the users to observe the surroundings so that after they can watch the stories. In relation to the users not being able to connect the stories to the specific place we are going to solve this by using markers more specific the d-touch markers developed by Enrico Constanza [32] how

they work is going to be explained ahead. Regarding the technical problems the visibility of the screen will be solved with the use of a different device which screen has a bigger resolution.

In the redesign of our system a specific attention will be given to solve the interface problems specially the lack of feedback after the users watch the stories and the dots that mark the stories.

Finally there is the traffic issue this is very hard to control but that will be addressed with the markers. The markers are going to be put in place so that people could watch the stories safely and without being disturbed.

Having done this user study we can now move towards the next generation of LAMS. Based on the pilot user study results, we have selected a number of improvements regarding the story design and the interactive experience. A change in the narration style as well as the use of marker technology is going to address the main issues highlighted during the study. A detailed description of the issues and how are we going to address them, is provided in the following chapter.

Furthermore, we plan to design a second user study to address the new features of the system and compare it to the previous one. The results of this study will be the main contribution of this thesis and will function as a base for reflections and conclusions.

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## **Chapter IV. Hypothesis**

In this section we will clarify the redesign that we propose to the iLand experience. In the previous chapter the problems uncovered by the user study were discussed inside four main categories, now we will make use of those same categories to further detail how we will redesign the system to improve the experience.

### ***1. Engagement***

In terms of the engagement in the experience the results were encouraging but some users reported a lack of context of the stories presented; this is one of the problems with higher priority to be handled. A narrator is going to present each story and make the user understand why he is seeing that specific story. The idea is to build a character that lived and worked in Rua Santa Maria who knows the street very well and introduces the audience to the lore and context of the area, in particular of the street, helping the audience to take in the atmosphere of the location.

Moreover users reported some usability glitches that can disrupt the engagement in the experience namely the small dot in the map that represents the stories and somewhat poor visibility of the screen makes some users miss some of the stories. Therefore a special attention in the colors used in the redesign of the interface will be given in order to increase the contrast between the map and the buttons to make them more visible, this combined with an increase of the button size will be enough to eliminate this issue.

### ***2. Location Sensing and Orientation Issues***

Some technical limitation affected the experience namely the fact that the GPS accuracy was sometimes poor; this problem is going to be addressed by using the markers developed by Constanza [32] these can be designed and interpreted by humans (see Figure 12). After the phone vibrates near the story the users need to look for the marker, upon finding it, they are sure to be in the right place for the story. Moreover the markers will be placed where people can watch the stories safely without being disturbed by cars and people who are passing by.



Figure 12 - Example of a d-touch marker (Left) and how is captured by the dtouch interface on a mobile phone (Right)

It was identified that it is hard to stay focused on the stories because of the surroundings and it can become an overwhelming experience. In order to contrast the overwhelming feeling it was decided to give some time to the users to observe the surroundings before watching the stories. This is accomplished by the narrator's introductions to each story where he points out a specific place and advises to observe these carefully; only after this time of observation the story begins. On the other hand it was notorious that there is a lack of feedback after the users watch the stories, they don't know what to do next or where to go next, the interface does not indicate in what direction the user should go. This issue will be alleviated by again, using the help of the narrator, after each story the narrator will intervene to give an insight about the story that the user saw, but also to leave an instruction for how to get to the next story.

### **3. Physical Landmarks and (Unfulfilled) Expectations**

New locations will be analyzed in order to see if a better fit between the stories and the locations is established that goes into the users' expectations. Moreover, we identified that people do not know where the stories are placed, this happens because they cannot relate the story to the specific place where it happened. This factor is also related to previous topics addressed but we will take into account the design markers to be related to each story so that users do not have any troubles finding the place to where the story is connected.

#### **4. Screen Capturing Attention**

Hopefully the combination of all the above solution will minimize the attention that users dedicate to the screen and maximize their attention to the street atmosphere and allure.

#### **5. Hypothesis**

Our proposition is to evolve into an application that goes beyond a map interface assisted by GPS to deliver stories into a cohesive experience for the users where the stories meaning isn't lost throughout the tour. In order to achieve this, the combination of watching stories into a real location shouldn't be overwhelming but instead immersive. We will design and implement a new system for delivering location aware stories involving a specifically designed narration style and the use of marker technology combined with some of the previous features from iLand. We will maintain the simplicity of the interface by continuing to use a map of the street as the main interface to orient the user through the experience. The narrator will introduce the stories to the users, describe specific places in the surroundings and let them take some time to observe the surroundings. Also the narrator will help them to find the correct place for seeing the story that is nearby, this place will be signaled with a d-touch marker. In this way the physical connections between the story and its surroundings, will be improved since the markers will be placed in specific parts of the street or close to special architectural features that are related to the story, for example, a balcony if the story happens on a balcony, or a door, window or special corner of the street. By looking and then searching for the marker the audience will connect more with the details of the physical place. After the user capture the right marker the user can watch the story. The narrator will intervene again after the story to point out important aspects related to the story as well as the relationship of the story with the surrounding and some clue to lead the users the next story.

Over the next chapters we explain the process of designing and implementing the proposed solutions.

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## Chapter V. 7Stories Prototype Development

The proposed re design originated a new experience that we called: 7Stories. Over the next chapter we will detail the whole process of designing the new experience. We will start by explaining how the narrator, the markers, the stories and the platform come together into provide a cohesive experience. Then we explain the process of designing and implementing the 7Stories story delivery platform.

### 1. 7Stories: Experience design

#### 1.1 Experience Name – 7Stories

We decided to name our experience the **7 Santa Maria Street Stories** being the short version **7Stories**. As we explained previously we crafted seven stories all of them are to be experienced in Rua Santa Maria downtown Funchal. Most of the stories share a religious or folklore related theme that fits the atmosphere of Rua Santa Maria, where old and religious people still spend time sitting with their friends chatting in the street, just outside their doors. The number 7 has also been said to be the most mystical number[40,41,42] hence the combination of all this factors that led us to name our experience: 7Stories.

#### 1.2 7Stories Experience

The 7Stories experience is derived by a combination of different factors: the markers; the stories; the narrator and the location. Figure 13 illustrates the relationship between all the factors. In the next points we will explain each of the components and how they contribute for the overall design, this will follow the exact same order that we followed to design the experience.

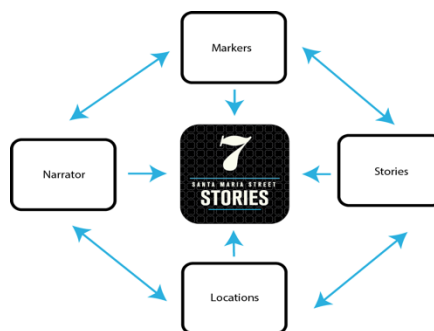


Figure 13- 7Stories Experience factors

### 1.3 Markers

The role played by the markers in our experience is very significant. It is related to the stories since the graphic design of the marker is deeply related to the content of the stories, the marker is placed in the location where the story happen and also the narrator mentions in his speech to the users clues about where markers are located.

In the next subsections we will explain the process of designing and creating the markers.

#### i Visual design of the markers

We started by comprehend the design rules for the d-touch markers, by looking at former examples of d-touch markers created. The rules to create a valid d-touch visual marker are related to the nesting of black and white areas or regions. In Figure 14 we can see one example of nesting where we have 1 black region containing 1 white region which in turn contains 1 black region.



Figure 14 - One level of nesting

In order to have a valid marker we have to follow the following rule [33] :

**“ A valid marker can be composed of a black region containing 3 or more white regions, and at least half of these white regions must contain one or more black regions. These makes exactly 3 levels of nesting – it must be no more and no less. However, there is no limit in the number and shape of the regions.”**

Having this in mind but not being constrained by this we started doing some sketches of what could be our marker for each of the stories. In Figure 15, it can be seen the initial results, to note that these initial markers do not follow the rules required but served as an excellent starting point.



Figure 15 – Initial sketches of the d-touch markers for each of the stories.

After this we loaded each of the sketches in the **d-touch analyzer**[34], the d-touch analyzer is a cross-platform desktop application developed to help in the design of valid d-touch markers and it revealed to be a fundamental tool for this process for designing the markers. Once the drawing is inserted into the analyzer it returns whether it is a valid marker or not. In case of not being a valid marker it helps out by pointing out what are the problems. In case of being a valid marker it returns the ID associated with marker. This ID is crucial so that we can later associate each marker in a unique form with a story, therefore we could not create markers with the same ID. In Figure 16, we can see a screenshot of the d-touch analyzer interface.

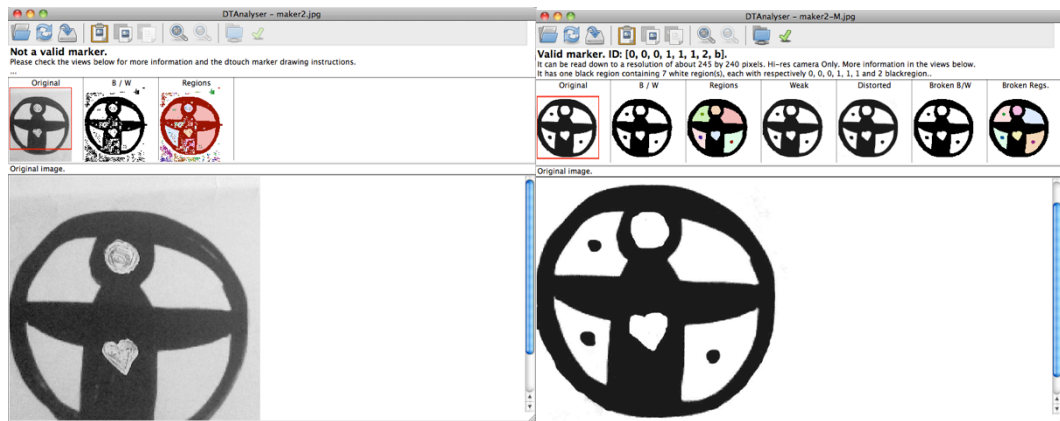


Figure 16 - d-touch analyzer interface showing: an invalid marker (Left) and valid marker (Right)

Subsequently we had to make several interactions on the design of each of the markers following the rules and advices of the analyzer to achieve a valid marker with a unique ID. This interactions where made without disregarding the aesthetics of the markers as well and what they had to represent, a sort of icon of each story.

In Figure 17, there is the final version of each of the markers with their correspondent ID and code name for the story which they belong to.



Figure 17 - Final version of the d-touch markers

#### **1.4 Connection between the markers design and story**

In this section we will explain relation between the marker visual design and its respective story. The multimedia video of each of the stories is stored in the appendix CD (Consult folder Multimedia Stories). In the first marker in Figure 17 we have an image representing the old witch of the story with the star imprint on the back, the same star that was transferred into the young girl. The second marker represents the milk being spilled into the levada, what the boy did, to go and play with his friends. The third marker illustrates one of the milk cans that were taken by the milk inspectors. In the fourth marker there is a representation of the Santo Antonio statue, the statue that the girl throws from her window. The fifth marker we can see an open scissor the object that was used to discover that the young girl was indeed a witch. In the final marker we have the representation of a human with the arms open like a cross, is a protection medallion, the one the farmer's wife gave to him and that ended protecting him from the witch.

#### **1.5 The narrator**

The use of a narrator is a well-documented narrative strategy. Its function is that of an orienting the reader through a collection of stories, which might be otherwise perceived as fragmented. Examples can be found in literary work since Boccaccio's Decameron (1351-1353), Chaucer's 'Canterbury tales' (1387-1400) or 'A thousand and One nights' (c.1450) where a woman tells stories to the sultans for a thousand and one nights in order not to be killed. The containing narrative strategy is called a

“framing narrative” and is often enacted through a narrator, in order to give the reader a certain framework under which all the stories can be interpreted and understood. In James’s ‘The turn of the Screw’, for example, the whole story is narrated by a governess, who could be insane as well as a hero and is in the reader’s interpretations what to make of her, and consequently how to interpret the whole story narrated by her [43]. This technique can have a powerful effect on the readers as they can frame the whole experience according to the role and voice of the narrator. We use such a strategy for improving the otherwise reported fragmented experience of 7Stories by its audience and help users find cohesion.

#### i The narrator character

The narrator was designed as a new distinct character, modeled on a real historical figure from Rua Santa Maria where the experience takes place. His name was Alexandre Rodrigues and he was a local iconic figure who lived between 1920 and 2003. He played a very active role in the local community as a businessman but also as a big supporter of the local sports club. He used to own a shop in Rua Santa Maria where the locals used to gather and share daily stories. So we suggest that these are the stories that our narrator is going to share with the audience. It will be up to the audience to decide if these stories are true or fictional.

#### ii The Role of the narrator

Apart from telling the stories the narrator has different functions and intervenes several times thought-out the experience. In the beginning of the experience he is the one responsible for introducing the system and explaining how the system works. This will happen in a form of a video with the narrator voice over.

Before each story the narrator points at features in the real environment to help users orient themselves and find the story but also where the marker is. It also serves to set the users mood for the story that they are about to see, for example before one of the stories, the narrator points users at a balcony that will appear in the video, so users can imagine that the story they are going to hear about, happened behind that balcony. After telling the story the narrator is also responsible for pointing out and reinforcing some aspects of the story that are connected to the surroundings. Moreover in some of

the stories he questions the audience to make them think on the story that they just saw.

In the annex CD, folder Narrator, can be found the entire script for the narrator and which story is he introducing or concluding.

We decided to keep the narrator interventions only in audio format to limit the demand for the audience visual attention. In this way we aimed at obviating the overwhelming feelings generated by having to find the story at its physical references in the real space and looking at the screen at the same time.

### iii Narrator Easter egg

In addition to the audio clips where the narrator introduces or wraps up the video clips of the stories, we also included an extra stand-alone audio piece, where the narrator points users to the building that was his home and shop. This content was not associated to any marker and it did not have a video clip related to it: it was deliberately different from the rest of the experience, and added as an “Easter egg<sup>2</sup>”, to explore how users would respond to a piece of media not associated to any marker.

## ***1.6 Overview of the Experience design***

In Figure 18, (in the CD, HD Images folder, a higher definition image can be found) we can see an overview of all the interaction points and trajectory of the user in the 7Stories experience. This visualization shows all the experience components: Location; Narrator; Stories and Markers. The picture gives us an overview of how all the components of 7Stories work together to provide an immersive and cohesive experience.

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<sup>2</sup> An Easter egg is an intentional inside joke, hidden message, or feature in a work such as a computer program, movie, book, or crossword. According to game designer Warren Robinett, the term was coined at Atari by personnel who were alerted to the presence of a secret message which had been hidden by Robinett in his already widely distributed game, Adventure, the name has been said to evoke the idea of a traditional Easter egg hunt [57].

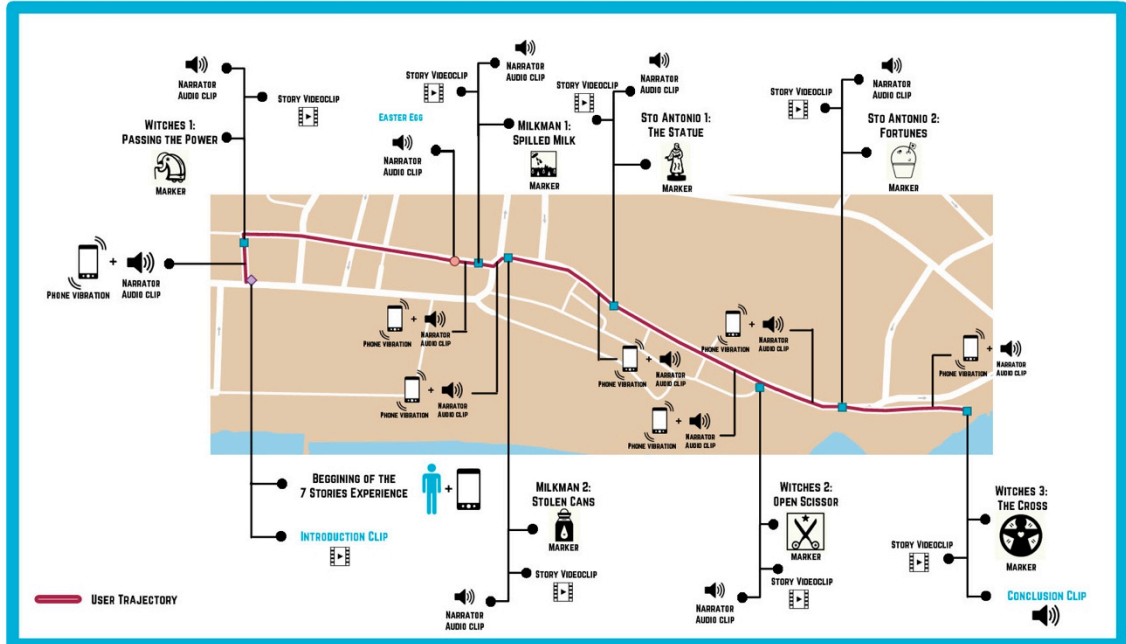


Figure 18 – Overview of the experience showing the interaction points and user trajectory in Rua Santa Maria

## 2. 7Stories platform design

### 2.1 Requirements

#### i Functional Requirements

We started by laying down what our experience delivery platform should be able to do and we stated that in a form of functional requirements:

FR1: The platform should be able to display visually the user and stories location in Rua Santa Maria;

FR2: The platform should be able to know when the user is near a story;

FR3: The platform should support the association of stories with physical locations;

FR4: The platform should support the association of the d-touch markers with the video-clip stories.

FR5: The platform should be able to support the users to capture the visual marker in order to retrieve the story associated with it.

FR6: The platform should store video-clip and audio-clips;

FR7: The platform should support the reproduction of video and audio clips.

## ii Non- Functional Requirements

It's import also to set down for the technical implementation how the platform will handle the delivery of the experience.

NFR1: The platform used to deliver the stories should be a mobile platform.

NFR2: The tracking of the user position should be done in real time using only the GPS data;

NFR3: The platform should support the integration of the d-touch library to recognize the markers;

NFR4: The platform will keep a record that associates the data location of the stories, the video-clip of the stories and the ID of d-touch marker;

## 2.2 The Process

As a supplement to the requirements and before entering the design the platform interface we needed to have an overview of the entire process, consequently we created the overall workflow of how the platform should behave and respond to the users actions according to the experience designed.

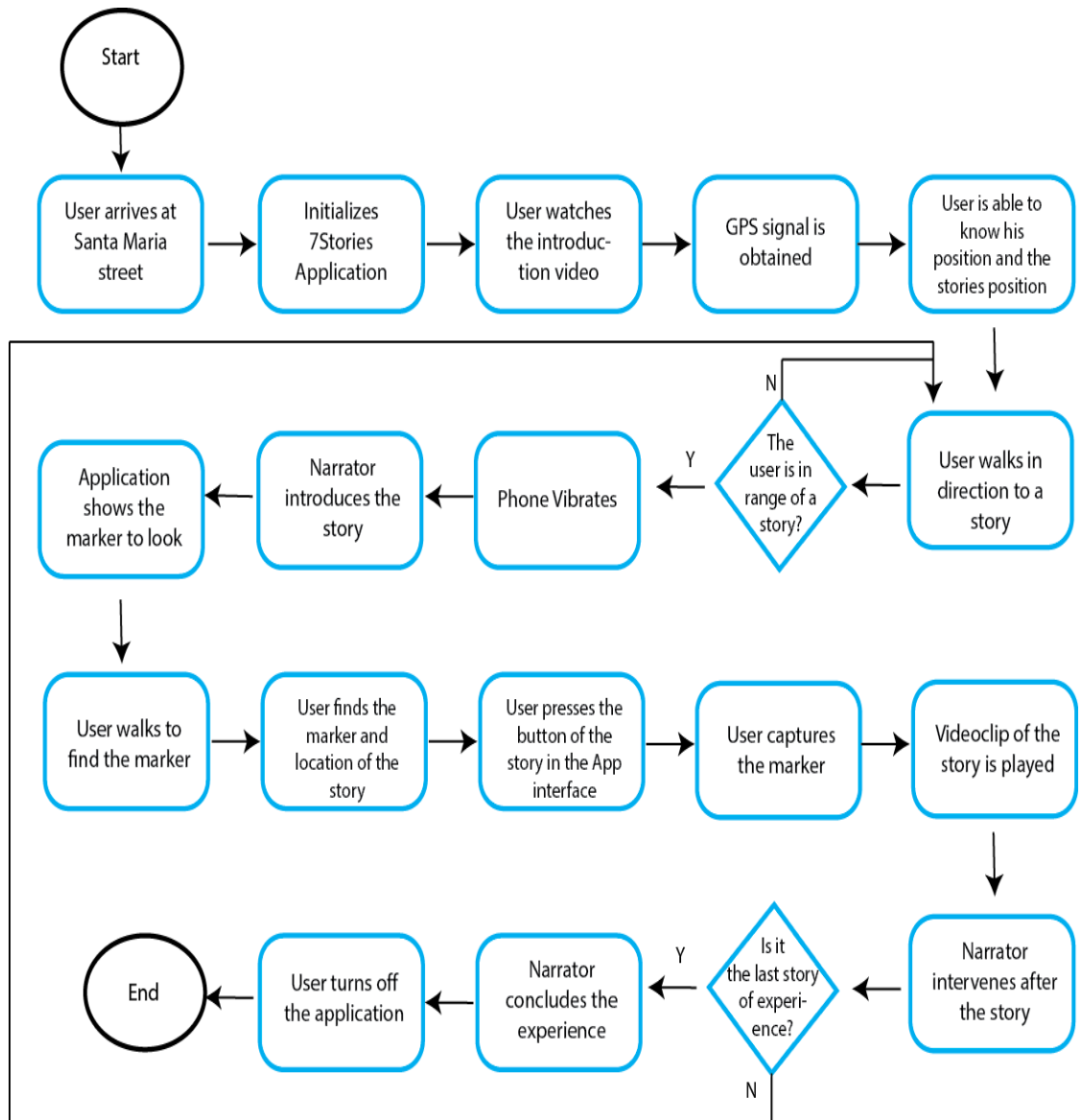


Figure 19 - Workflow of the 7Stories Story delivery platform

## 2.3 Low and mid-fidelity prototypes for the mobile application

In the following sections we present the prototyping activity that informed the final design and implementations of the 7Stories application.

### i Low Fidelity Prototype

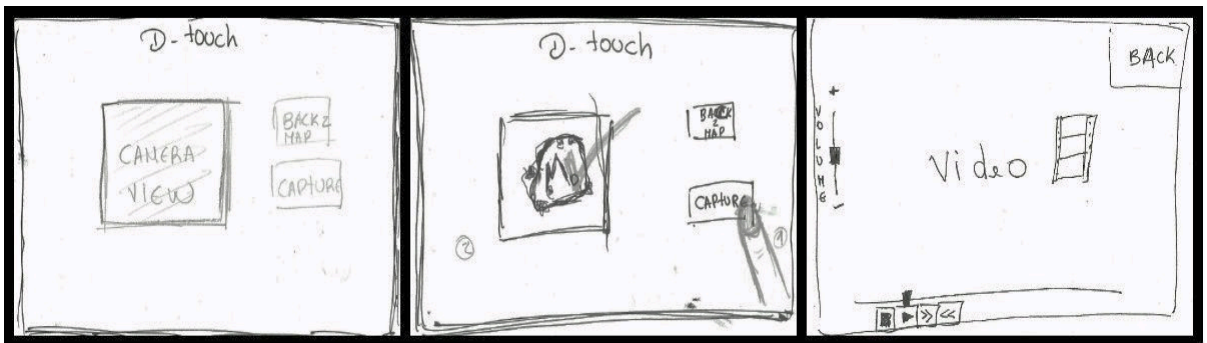
In this section we present the low fidelity prototypes for the 7Stories. From the initial study we identified that people felt comfortable using a map based interface so we decided to keep that as the base of the interaction in the 7Stories mobile application. Several low fidelity prototypes to test out different ideas and concepts about how the application should interface between the stories and the audience were created. As a result of the low-fidelity prototype, we learned how to manage the action/reaction relationship between users and the system; meaning when a user takes action how should the system react in order to provide the best experience possible. We tested the low-fidelity prototype among a few colleagues at the University; engineers and designers opinion was taken into special account. We learn how important it is for a potential user to have some kind of feedback while the GPS is connecting to the satellite, or to have feedback when the marker is captured correctly. Without this kind of feedback from the system the users might not understand when or if they are taking the right actions to complete the experience or not.



**Figure 20 - Welcome screen of the mobile application, loading the assets (Left) ; Feedback while the GPS signal is not received; Showing the location for one of the stories (S1) which is also a button. (Right)**



**Figure 21 - Screen showing user position on the map; User position has a range around it (Left) ; Visual feedback once the user position overlaps with the story position (Right)**



**Figure 22 – After the user presses the S1 button the interface changes to capture the marker of the story - Using camera view (Left); After pointing the camera phone to the marker on the street the user captures it (Center); The video-clip of the story plays allowing the user to control de clip (Right)**

## ii Mid-fidelity Prototype

Once we defined how the application would respond to the users and its sequence of wireframes screenshots, we proceed in defining how should it look like. In Figure 23 we can see that the map has a small church, users find that helpful in orienting themselves and also mentioned that it made the map look less empty. We decided to include in the map design visual references of the more iconic buildings along Rua Santa Maria this will work as a visual reference for the users so that they are always aware of where they are.

Another important decision made thanks to the feedback to the mid fidelity-prototype was showing a sample of the marker that the user should look for when he is near a

story, like we can see in Figure 24. It was mentioned by one of our testers, that in fact it would be easier to find something, if they already knew what they were looking for. It was interesting to observe through the process of showing our low and mid fidelity prototypes how much the consulted users wanted to contribute with feedback and ideas in terms of the interaction and appearance of the application. Such detailed and proliferous contributions did not happen during the field trial. We can infer that low and mid fi prototypes are very helpful to elicit feedback from the users, as their incomplete and sketch like look encourages participation and suggestions, while the field deployments gets user more prone to believe they are being tested in their skill of making the application behave correctly.



Figure 23- Map interface showing location references, story buttons and user location

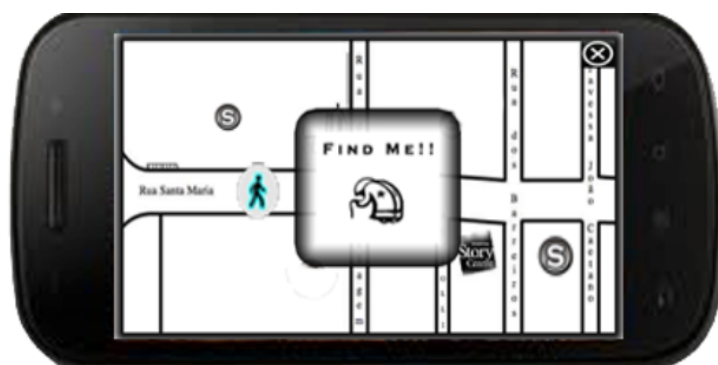


Figure 24 - Pop-up of the marker that the user needs to find and capture



Figure 25 – Marker feedback when the marker captured is the correct



Figure 26- Video-Clip playing in full screen

## ***2.4 Final Graphic Design***

After informally evaluating our low fidelity prototype we had a clear idea for the assets needed for the mobile application interface and we created a polish version of the graphics. For this task, we worked together with a graphic designer. We wanted a look and feel that would enhance and convey the experience of exploring the mysteries and folklore of the Funchal old town, with particular attention to its community and tradition. Using the mid-fidelity, to explain and show to the graphic designer, the type for interactions that we had in the application all the graphics were created and implemented and loaded on the smart phone. Over the next images we will show and explain the different elements of the graphic interface and the inspiration of them.

## i 7Stories Icon

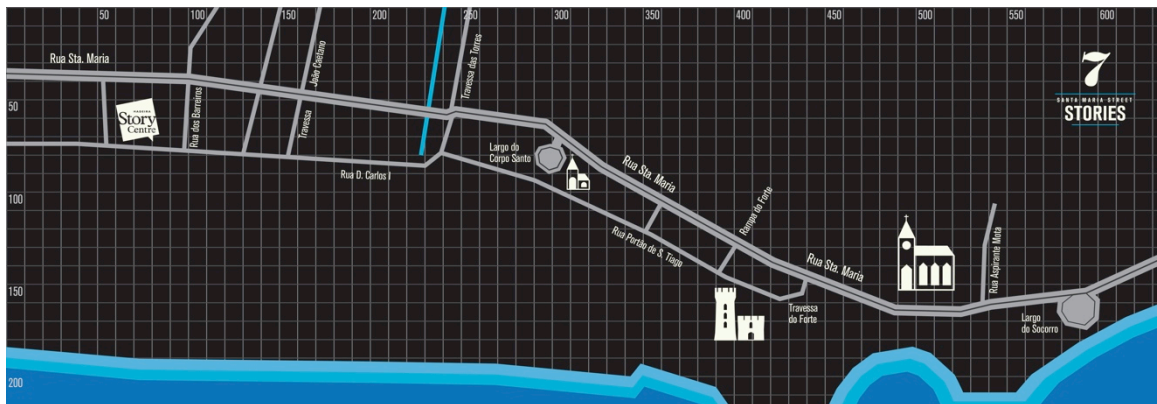
In Figure 27, we can see the icon designed to represent for the 7Stories application. This is the first thing that users will see since it's used to initialize the application from Android's list of applications in the mobile phone. For us it was important to have a the icon represents the experience properly. Its design is very simple the 7 and the Stories stand out, so it's clear what's the name of the experience. In the background there's a pattern with the same shape used for the stories icon.



**Figure 27 - Icon for the 7Stories Application**

## ii 7Stories Map

The map of Rua Santa Maria used in the 7Stories interface was custom made in order to give the application a distinctive look, different from a location based service, that helps tourist position themselves and find restaurants and other amenities. We wanted the 7Stories application to be a unique experience, closer to a narrative experience rather than a GPS navigator. The Map, Figure 28, is showing the main path that users have to walk in order to encounter the stories and their markers, as well as the most important landmarks along the street.



**Figure 28 - Graphic design of the Map used in the interface**

### iii 7Stories Color Scheme

For legibility of the mobile device screen we used a limited and very specific color pallet: Black; White; Grey and Blue. We used the black and white to achieve a higher contrast since our initial user study reveled that due to the sunlight it could be hard to see the interface, we chose to use colors that would create a high contrast. Moreover the colors black and grey fit the theme of most of the stories, since they that have a dark and mystical theme.

### iv 7Stories buttons

In Figure 29, we can see the icon that represents the stories on the map, therefore wherever there's a story on a certain location it will be identified by this icon. Moreover when the user presses the button, to access marker capture mode, it triggers a small animation as feedback.



**Figure 29 - Story Button (Left): Inspired by the shape of windows in Rua Santa Maria (Right)**

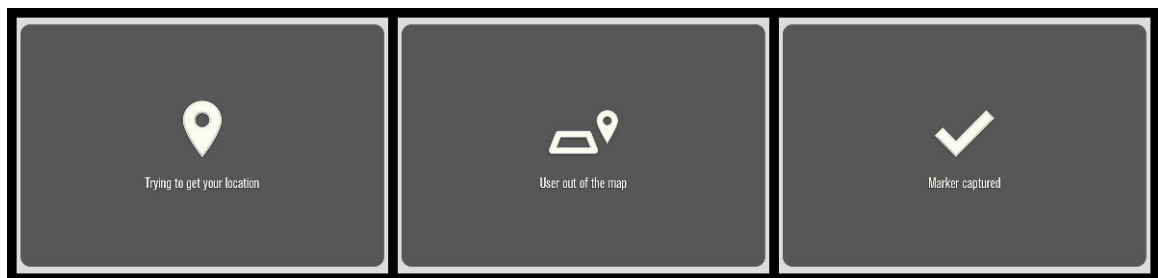
The following button, Figure 30, is located at the top in the right side of the screen, is to be pressed if the wish to exit the application



**Figure 30 - Close application button**

## v 7Stories user feedback

It's important for the user that the interface responds to the users actions by giving them some sort of feedback. Feedback is used to engage, explain, and it can even transform a confusing experience to a pleasant experience that clarifies the users how the system works. Therefore in our application it's important for the users to know what is happening at all times, the elements present in Figure 31 and Figure 32 show how we give feedback to our users regarding: the GPS data, where the user is, and if the user captured the marker correctly.



**Figure 31 – Feedback give while the application is obtaining the GPS data for the user position; Complemented by an animation of a spinning wheel. (Left) ; Feedback if the user goes away from the path designed for the experience (Center) ; Feedback once the correct marker is captured (Right).**



**Figure 32 –Once the GPS data is obtain we can see on the interface the green icon ( Center) and the blue icon (Right) ; The Blue icon represents the user and the green icon represent that the application is receiving the GPS data.**

vi 7Stories High fidelity prototype

The following Figures (33, 34, 35, 36, 37) illustrate the high fidelity prototype interface and all the different elements combined in the user interface. The high-fidelity prototype is supposed to be very close to the final product in order to be able to examine usability questions therefore in this high-fidelity prototype its possible to see lots of details and functionality. The high fidelity prototype was optimized for a Samsung Nexus S screen with 480 x 800 pixels, 4.0 inches (~233 ppi pixel density). Again we showed this informally to some people to get their feedback and insure that we were in the right track before moving on to the implementation of the prototype.

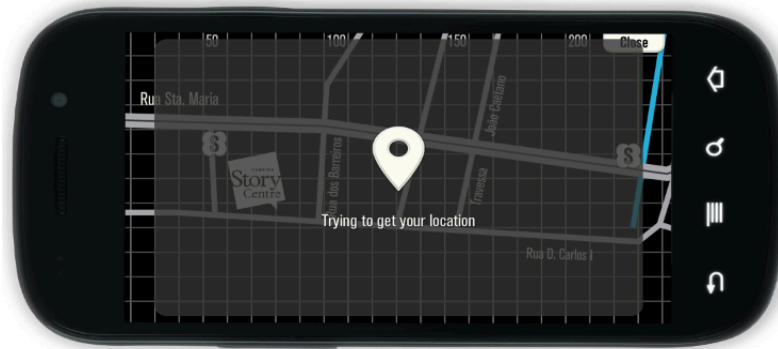


Figure 33 – Screenshot of when the user begins the 7Stories experience



Figure 34 – Screenshot of the interface showing the user location icon, the GPS icon, the close button and the stories location icon



**Figure 35 – Screenshot of the marker pop-up message when the user is near a story, this is comes in a form of an animation that after 5 seconds disappears.**



**Figure 36 – Screenshot of the interface after the user pressed the stories button and entered into the capture the marker mode**



**Figure 37 – Feedback for a successful capture.**

## 2.5 Storyboard

In order to design for our users the best and smoothest experience of the 7Stories of Rua Santa Maria, we developed a storyboard. It illustrates the overall flow of actions and interactions between the user and the experience in this case our user is John, a tourist that is visiting Madeira for the first time and that decides to try the 7Stories experience.

The storyboard also serves as a help to visualize what happens in the user study that will be explained in the evaluation chapter.



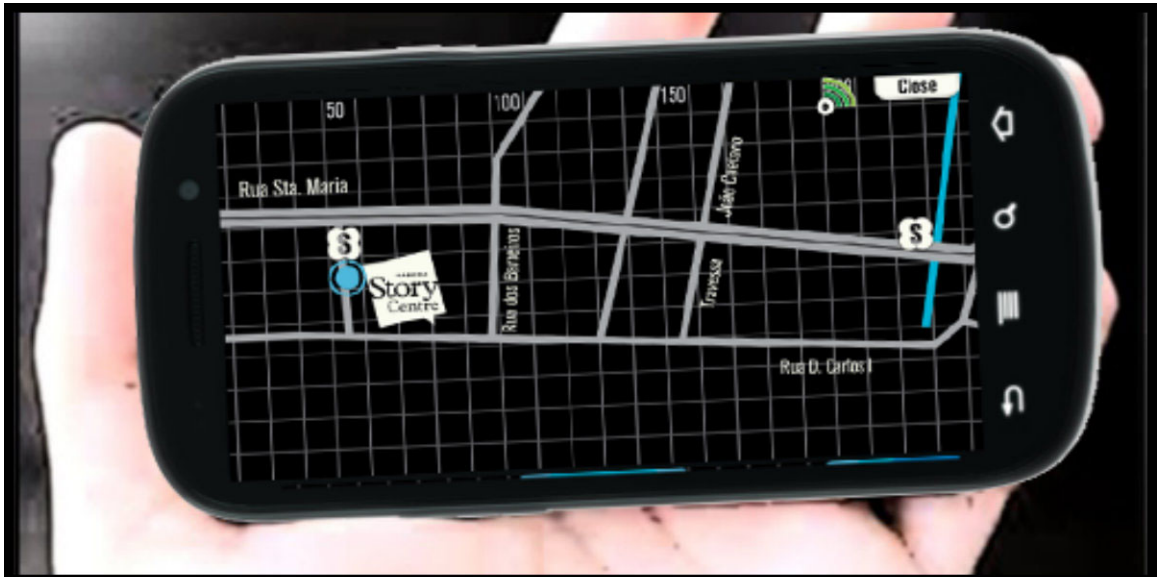
John recently arrived at Madeira, while his wife is resting at the hotel he decides to go for a walk, as he passes by the Madeira Story Centre he sees an add about a new tour that the Story Centre is providing. He decides to enter and ask for information's about the tour at the reception desk.

The lady at the reception desk briefly explains that is an experience where John will be able to discover some hidden folktales about Madeira's habitants. The tour is along Santa Maria Street with the help of a mobile application. As John agrees to take the tour the lady provides him with a GPS equipped phone with the 7Stories application in exchange of a small free and the ID card that will be returned at the end of the experience.



Shortly after, John starts the tour by seeing an introduction video; the video explains the 7Stories experience and how to interact with the mobile application. Also it's in the video that John first is introduced to the "host" of the tour, the narrator, Alexandre Rodrigues.

Once the video is over, John starts exploring the street looking for the first story.



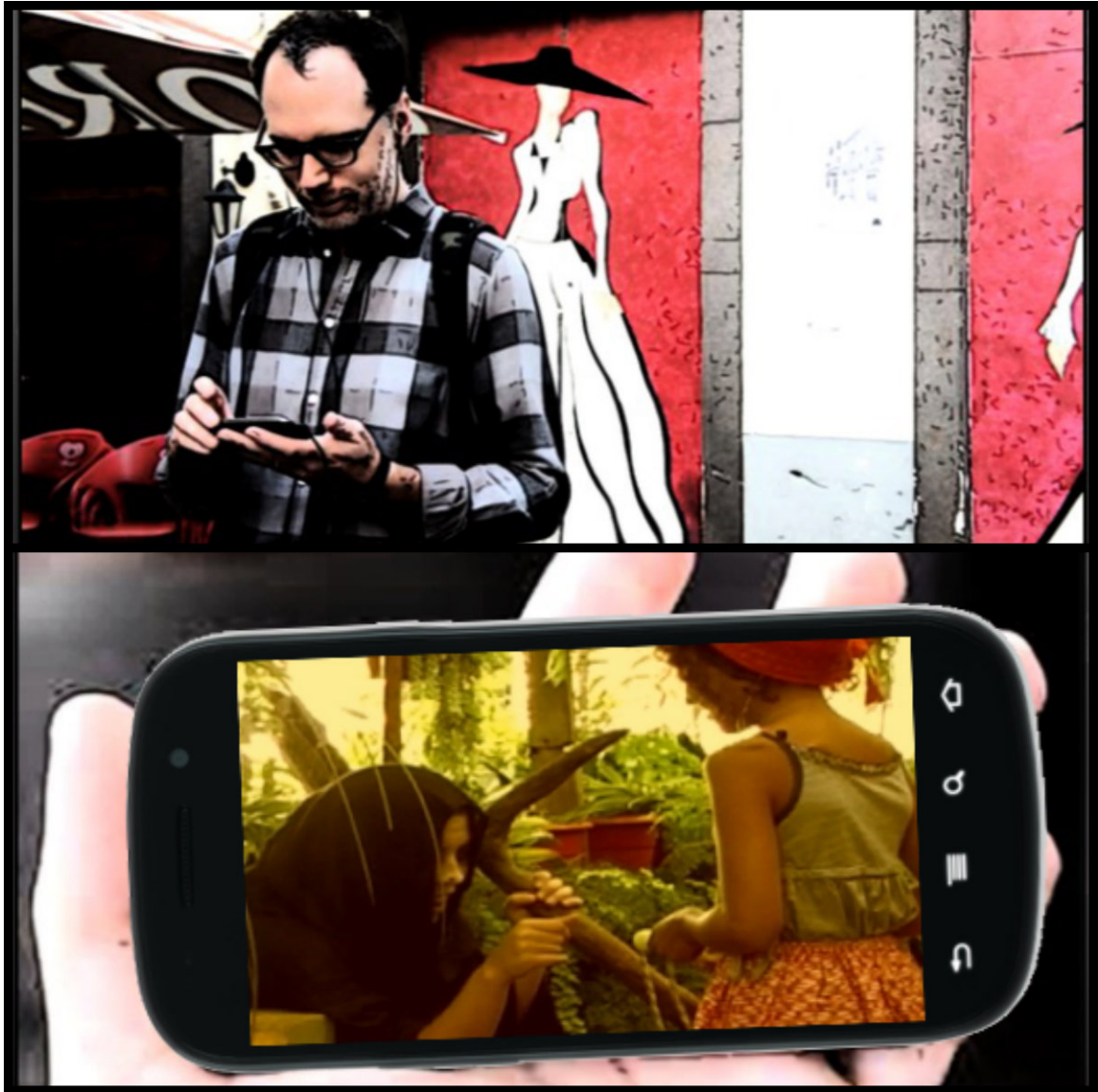
Just a few meters ahead, John notices the story icon is close to his position indicating that there is a story close by.

Shortly after the phone vibrates and John starts listening to the narrator introducing the first story and also giving a clue to where the marker of the story is.

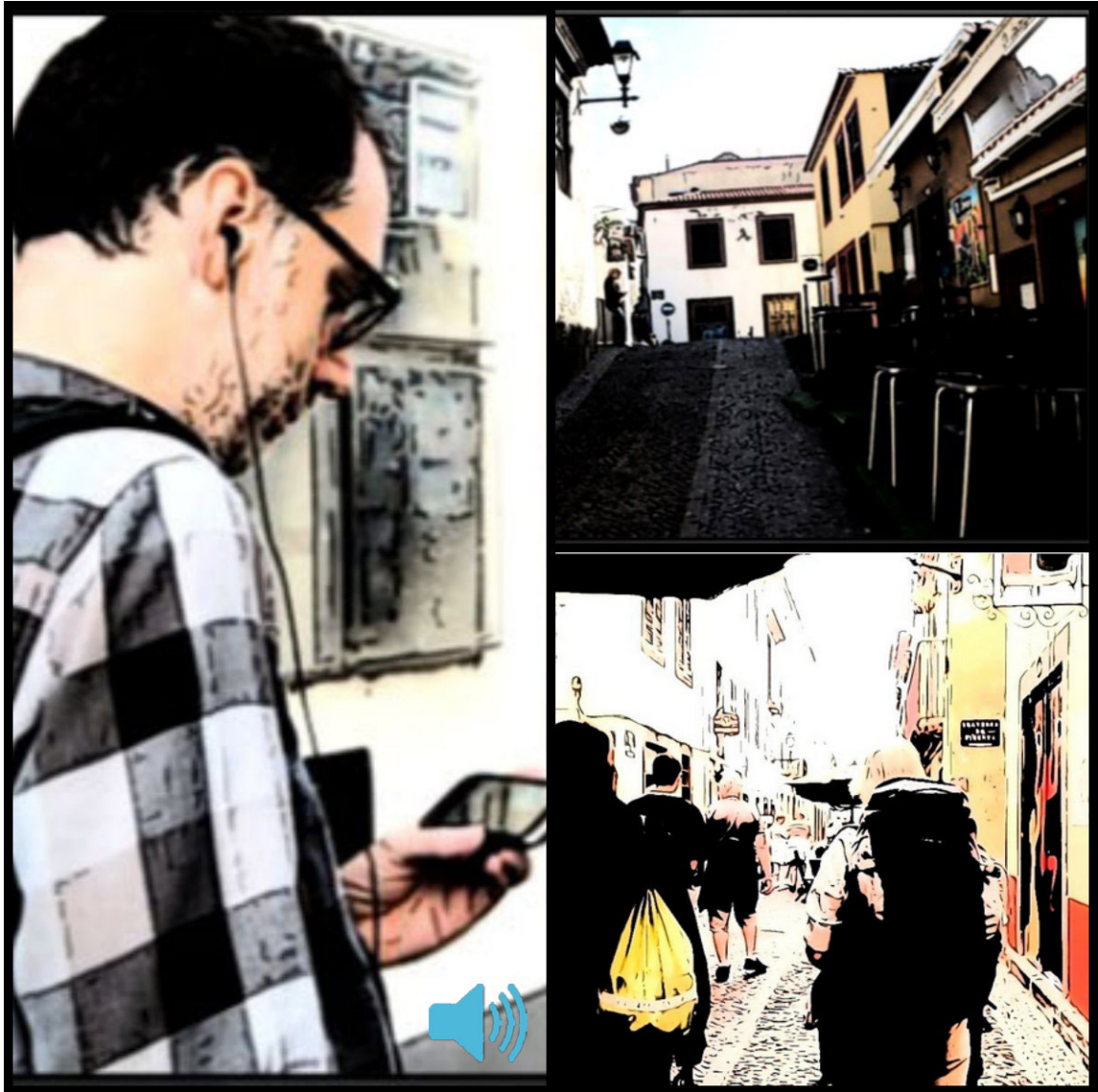


At the end of the audio clip, an image is showed of which marker the John needs to find.

After finding the marker, John captures it with the help of the application.



John now can enjoy the video of the first story.



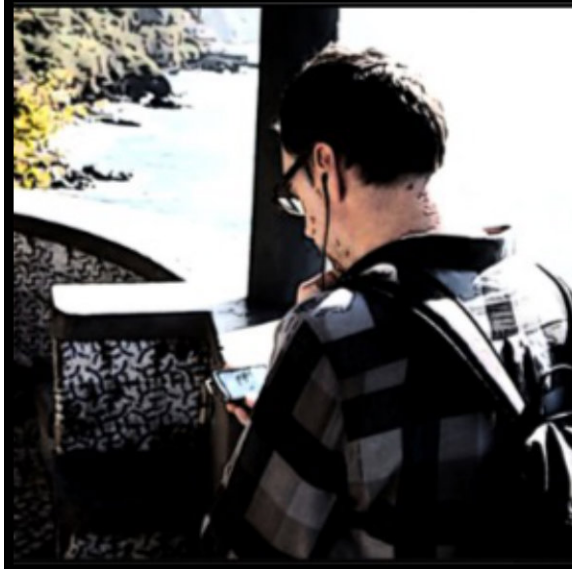
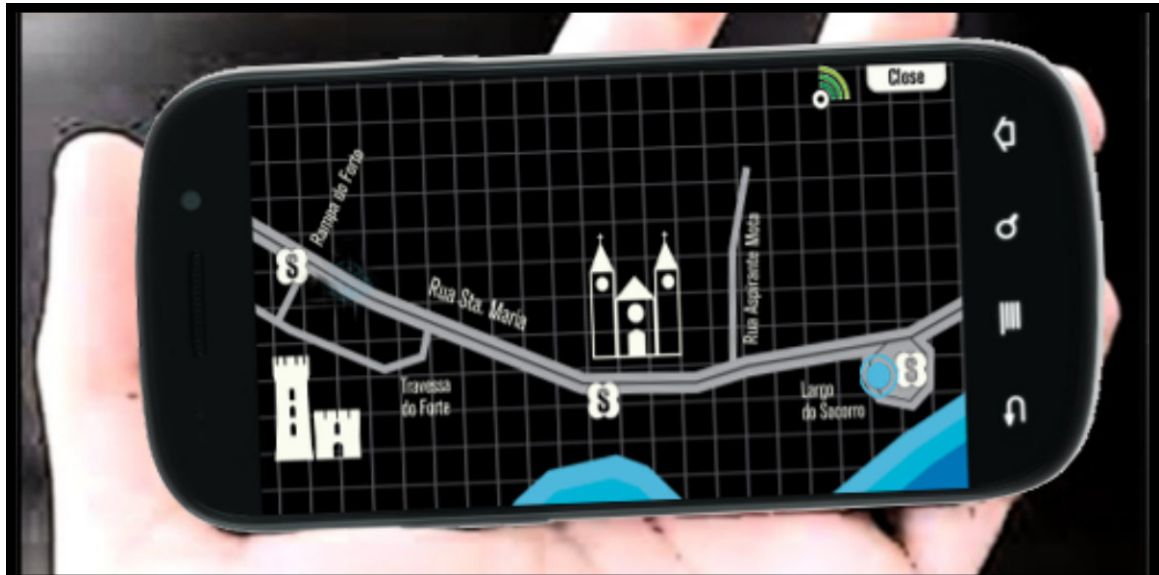
Brief moments after John finished watching the story, the narrator intervenes again in audio format, calling for John's attention to look for the window where the story happened. Also the narrator gives some pointers to where John should go next. John continues walking along Rua Santa Maria looking for more stories.



As John passes by the narrator's old house, where the city hall added a small tribute sign, the narrator intervenes with an audio clip calling for John's attention to the sign. A few meters ahead John can also see the entrance to the narrator's old business shop.



John continues the tour, finding the remaining markers, watching the stories and enjoying the surroundings of Rua Santa Maria.



John gets to the viewpoint at the end of Rua Santa Maria where the last story is placed. After John watches the story, the narrator concludes the experience and says goodbye.

### 3. Prototype Implementation

The 7Stories prototype was developed for the Android platform using Flash Actionscript 3.0. We choose ActionScript 3.0 because it is a powerful, object-oriented programming language ideally suited for rapidly building rich multimedia applications [44]. 7 Stories comprises several applications (See Figure 38), the “main application” implements the main interface of the 7Stories prototype and depends on another application (“d-touch”) to recognize the markers. d-touch has dependencies, which are also represented in the Figure. In this section we will explain all the process used to make these layers work together to accomplish the 7Stories mobile application. We describe the modules from the core of the application to the outside.

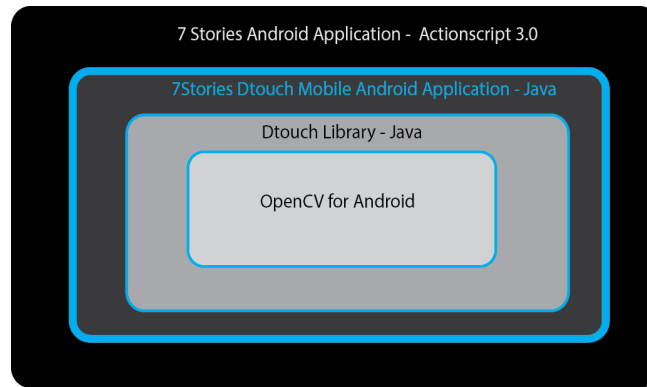


Figure 38 - 7Stories mobile application modules

#### 3.1 d-touch Mobile

As mentioned before integrating the d-touch library in our application was one of the key aspects and we used an open source Android implementation of the d-touch system developed by Shakir Ali, under a research project for Horizon Economy Research Institute in the University of Nottingham [45,46]. The source code was available on github [47]. We have explained briefly how the d-touch markers work so in this section we will only explain the steps to implement the android project using the d-touch mobile library.

##### i OpenCV

d-touch mobile library uses OpenCV to read images and detect regions. OpenCV is an open source computer vision and machine learning software library. OpenCV was

built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception for commercial products [48].

#### ii d-touch Mobile library

We used the Eclipse development environment [50] to import the the d-touch library project downloaded from github. Like we mentioned before the d-touch library uses OpenCV, therefore we added the OpenCV for android project as a reference for the d-touch library. Without this step we couldn't use the d-touch library since many of its functions would not be recognized and we would not be able to compile the DtouchMobile project.

#### iii d-touch sample application

Afterwards it was necessary to create the application that would detect our markers. We edited upon one of the samples provided by the author, located in the downloaded folder from github called *DtouchSample1*. After importing into our eclipse environment we added the d-touch library project as a reference of this sample project. As this point we could compile and send the *DtouchSample1* application successfully to our mobile phone. Our prototype was deployed on a Samsung Nexus S mobile phone using the Android 2.3.6 operating system.

#### iv d-touch 7Stories application

In order for the d-touch application to recognize the our markers we had to make some minor changes in the *HIPreference* class used to store the preferences which are necessary to define the constraints for the d-touch markers. Basically this means that we changed the levels of nesting originally allowed in the sample. For more detailed information's about the d-touch implementation there is documentation available in the authors website [51]. It was necessary to change the settings of some parameters for the first set that defines the type of the d-touch markers which d-touch mobile library should detect. To be more precise we changed the following parameters:

- Minimum branches: It defines the minimum number of branches a d-touch marker can contain; initially it allowed 2 and we changed to 4.
- Maximum leaves: It defines the number of leaves a branch can contain; we changed this parameter from 3 to 10.

Moreover we adapted the d-touch application so that it could communicate with our 7Stories actionscript application through a local host socket. This was done using *Intent* on the Java application side, which is an abstract description of an operation to be performed. Its most significant use is in the launching of activities, where it can be thought of as the glue between activities [52].

On the actionscript application side we used the *navigateToURL()* function that opens or replaces a window in the application. In this case we have to pass as argument the name of the application that we want to open – dtouchsample. In Figure 39 and 40, we can see the code snippets used on both ends to establish this communication.

```
idStory=idButtonClick;
markerIdFinal=x+markerId;
storiePathFinal=x+storiePath;
idStoryFinal=x+idStory;
navigateToURL(new URLRequest ("dtouchSample1:"+markerIdFinal +storiePathFinal +idStoryFinal));
```

Figure 39 - Code snippet from the actionscript side - the main applic

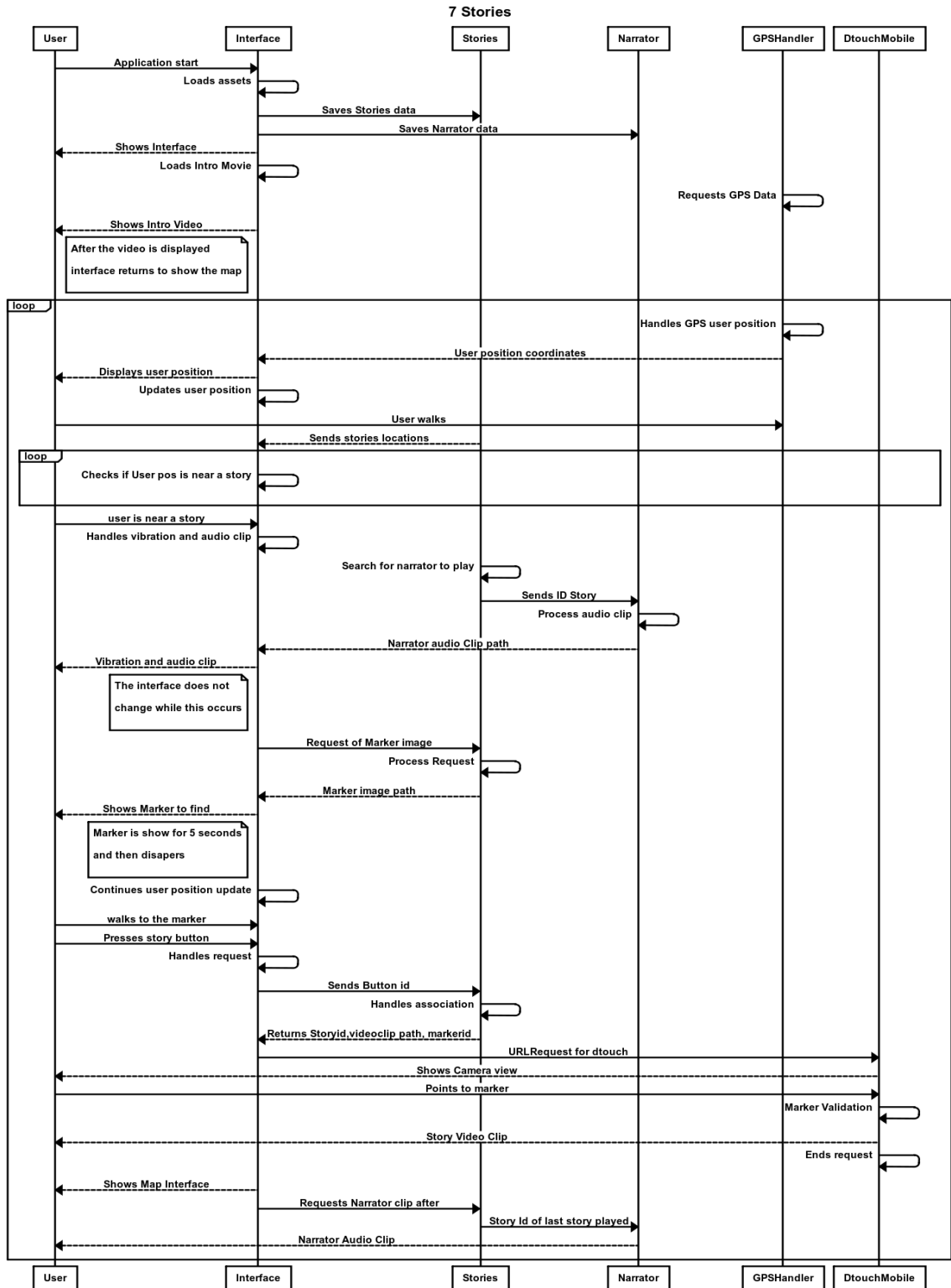
```
// get data from main app
Intent intent = getIntent();
Uri uri = intent.getData();
var = uri.toString();
```

Figure 40 -Code snippets from the Java android application - dtouch reader

### 3.2 7Stories main Application

In this section we will discuss the architecture of the 7Stories main application. There are four main components in the 7Stories application: Interface handler, GPS Handler, Stories, Narrator and DtouchMobile.

The sequence diagram in Figure 41 (Appendix CD, [HD Images](#) folder for high definition image) shows the sequence of functions layed by each of the components in the 7Stories application.



www.websequencediagrams.com

**Figure 41 - Sequence Diagram of the 7Stories application**

Next we describe in further detail each of the main components and the role that they play in our mobile application:

### i Map

This component is used to load all the assets and store the information related to them. We implemented the 7Stories in a way that all the data is loaded and created from text files. This allows flexibility to add and remove content. Therefore all the information needed is stored in the text file; we store the path of the map, the dimensions and the reference points. In this way we can easily change the location where the experience is deployed. We also store the number of stories, their respective video clip paths, ids, marker ids associated and their position on the map. In addition, we store the information's about the narrator, the id the path for the clip to be played before the story and the path for the clip to be played after the story. Moreover there is a file with the information for our Easter egg.

The map interface is loaded according to the information stored. For instance, if we have nine stories in the *StoriesInfo.txt* file, nine icons will be added in the stories map interface. To note that these files can be edited by anyone who wishes to design a similar experience since they are in a text file that follows a simple logic. In Figure 42 we can see a sample of the *initialSettings.txt* file and the *StoriesInfo.txt*. Moreover it is worth to mention that these files are stored in the phone SDCard. For more information's on how to edit these files or too see the structure of the Readme.txt please check the appendix CD in the Technical Files folder.



Figure 42 - Sample of the *initialSettings.txt* (Left) and sample of the *StoriesInfo.txt* (Right)

The *Map* entity is also responsible for all the calculations necessary to transform the data received from the GPS sensors into pixels units and to keep this updated.

Like we mentioned before the map is offline, therefore we have to perform all the calculations to transform the latitude and longitude data into pixels for the map image. For that we created an algorithm that translates the user position from the GPS coordinates into pixels coordinates that allows us to display the user icon on our graphic interface. It is the map entity that keeps on verifying if the user position is overlapping with any story position. If so it sends a request to the stories entity to retrieve the information's about them namely the ID so that it can send a request for the *Narrator* entity to get the audio clip that needs to be played. Also it triggers the *Vibration* event. Moreover the map is always listening for touch events in the stories buttons, if the user presses the button of a story the *Map* entity is responsible for identify which one was pressed. Then it will retrieve the information stored in the *Stories* entity about the marker id, the story id and the video clip path so that it can send the parameters to the d-touch application via the `URLRequest()`.

#### ii Stories

This is the component responsible for storing all the information about the stories namely all the stories id's, the stories coordinates in the map, their video clip path, and the marker id associated with each story. It is also responsible for storing if there is a story in range of the user and if so which one.

#### iii Narrator

The narrator component is responsible for storing all the information about the narrator namely the narrator ids, the audio clip paths and also its responsible for handling the special case of the easter egg which is also a narrator audio clip.

### **3.3 Limitations of the 7Stories mobile application**

Currently we can only deploy our prototype application on Android Gingerbread - 2.3.6. We tried to deploy the application in newer versions of the Android OS, namely with Android Ice Cream Sandwich 4.0.1, and although the "main application" was perfectly compatible we failed to compile the d-touch mobile application. This is because d-touch was developed using a version of OpenCV that is only compatible with the Gingerbread version of android for now. In order of this to be compatible an update to the d-touch mobile application and library would be required, which is out of the scope of the current prototype.

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## **Chapter VI. Evaluation of the 7Stories Experience**

In this chapter, we describe the evaluation, of the 7Stories experience. We will present reflections and insights based on the user study and finally extract some general guidelines for the future design of location aware storytelling applications of this kind.

We designed a specific study for 7Stories in order to understand if our redesign did alleviate some of the issues uncovered with the previous version. We wanted to analyze if 7Stories was working as a satisfying interactive narrative experience without creating overwhelming and frustrating sensations. Especially regarding the perception of stories on the move and the relation with the surrounding environment. Furthermore, we wanted to test if the experience conveyed a charming atmosphere and history of the old city of Funchal and if users would leave with a pleasurable sense and more in depth knowledge of the old part of town and its atmosphere. The study was also intended to uncover general issues regarding the interface and the interactive design of the system in order to improve its usability. In particular further investigations were made specifically towards understanding the impact of the markers and the addition of the narrator in the experience.

### ***1. Evaluation method and Pilot study***

A qualitative study was designed and conducted to evaluate the prototype. For this evaluation, to simulate a more realistic practical scenario for the deployment of this kind of technology we connected with a local museum near the location in the old part of the town where the experience would start.

Similar to the first study of the iLand experience, we shadowed participants as they interacted with the 7Stories system, and documented this observation through written notes and photographs.

Before the actual study, a pilot study was conducted to test the evaluation protocol we designed. One user was engaged with 7Stories for 30 minutes, while being shadowed. Afterwards we asked participant to respond to a questionnaire of 30 questions, taking approximately 20 minutes to complete. The questions explored how participant felt about the system and the content, including the relation between

stories and physical surrounding and the role of the narrator. The questionnaire was followed by a short semi-structured interview to discuss anything that participant felt was missing in the questionnaire. The interview lasted approximately 10 minutes and was documented through notes by the experimenter who conducted it. The pilot was very helpful on several levels, it helped to fine-tune the protocol in terms of duration of the overall test, the best time of the day for the screen to be visible, to insure that the questions made in the questionnaire were clear to the users and generated useful data for us. We also deduced, that in general the experience should be discouraged if the weather doesn't comply. In fact the pilot happened to be on a cloudy day and the GPS behaved erratically spoiling the experience for the user, therefore we decided to conduct the study only with clear sky conditions. During the pilot study, we also refined the exact locations for each of the markers and where exactly should the narrator be triggered by the system. Moreover, we learned that all aspects related to the use of technology and its interface should be clarified to the users before the experience starts and every effort should be made to ensure that the users feel comfortable with it before starting the tour. Therefore, in order to do this, we decided to produce an introductory video to the 7Stories experience to provide instructions about the basic functioning of the system.

This video was showed to the participants inside the museum on the same device used for the rest of the experience, and lasted approximately 1 minute and 30 seconds. The video clarified to the users all aspects related to the use of technology and its interface before the experience started, so that users don't feel overwhelmed by the amount of information they have to deal with during the experience of the stories. The video also serves to entice the user and put the user in the right mood for the experience. Please refer to the CD Appendix, Folder: Multimedia Stories, File: 7StoriesIntro.mp4 in order to watch the intro video of the experience.

Moreover, to probe further how users perceived the markers, if they liked them and found them useful, so we decided to send the users an additional questionnaire, this was done approximately 2/3 weeks after the user study. Please refer to the CD Appendix for the questions and results on this questionnaire (Folder: Evaluation Chapter Documents\FollowUpQuestionnaire).

## ***2. Participants demographics***

Participants were recruited from the university and through the researchers social networks. 12 English-speaking users took part: 4 locals and 8 foreigners (3 tourists and 5 residents). 6 of the participants were university students from different disciplines (Human Computer interaction, design, psychology) and 6 were professionals from various fields (real estate, veterinary, school teaching, software engineering). The sample included 6 women and 6 men, with age ranging from 20 and 41 years.

3 of the participants were very comfortable using technology, 7 were comfortable and 1 was not comfortable. 10 of the users were familiar with location based systems like for example the ones used for orientation used in cars, but only 4 have used a location based system with entertainment purposes like for example location based app for geocaching, the Bram Stokers app (a storytelling game about Dracula stories), or locations based systems in museums like the one that exists in the Louvre museum. Users were left free to decide whether to experience the system individually or in pairs. 4 users went out in two pairs and the rest individually. See table 1.

For all the participants, we followed the methodology described above where during the tour we observed the participants' reactions (shadowing). The experience by itself lasted between 30 to 40 minutes. At the end of each tour, a questionnaire was conducted with each single participant then followed by an informal interview.

<b>Group Size</b>	<b>Participants / Age range</b>	<b>Background</b>	<b>Familiarity with technology</b>
1	João ( 24-29 years )	Born in Madeira and raised in Jardim do Mar a village in the interior of Madeira, not familiar with Rua Santa Maria. João is a psychology student.	Comfortable with using technology.
1	Nuno ( 24-29 years )	Born in Madeira and raised in Santa Cruz a city near Funchal he is familiar with Rua Santa Maria. Nuno teaches in a high-school coursed on electricity and networks	Comfortable with using technology
1	Luis ( 24-29 years )	Born in Guatemala, foreigner not familiar with madeira Culture had passed by Rua Santa Maria once before. Luis is a human-computer interaction student.	Very Comfortable with using technology
2	Fernanda and Davide ( 24-29 years )	Fernanda is from Belo Horizonte, Brazil; she has a background on international relationships management but is currently studying human aspects of technology. Davide is from mainland Portugal; he works for the army and is also a design student. Both of the users moved recently to Madeira	Both Comfortable with using technology
2	Nadia and Renata ( 24-29 years )	Nadia is a local she was born and raised in Funchal and Renata is from Hyderabad, India she moved to Madeira recently to study. Both are studying human computer interaction.	Nadia is comfortable with using technology Renata is very comfortable with using technology
1	Manuela (36-41 years)	Manuela is from Italy she had visited Madeira before. She works in the field of veterinary .	Is not comfortable with using technology
2	Justino and Natercia (18-23 years)	Justino is from the mainland and moved to Madeira a couple of years ago he confessed that he wasn't very familiar with Madeira traditions and culture but has been before in Rua Santa Maria. Natercia is a local born and raised in Funchal and passes by Rua Santa Maria occasionally. Both are students Justino studies design and Natercia studies English.	Both are comfortable with using technology but do not own smartphones
1	Lucas (24-29 years )	Born in Madeira raised in Camacha a village of Madeira. He is familiar with Rua Santa Maria. Lucas is a software engineer	Is very comfortable with using technology
1	Juliana (36-41 years)	She is from Funchal and is very familiar with Rua Santa Maria. Juliana is a real estate manager.	Comfortable with using technology

**Table 1 - Description of the users background; the names of the users are fake to keep the user anonymity.**

### **3. Evaluation Results**

The notes from the observations and from the interviews, as well as the text entered by participants in the questionnaire were coded through open codes, and then grouped in four categories, each described below.

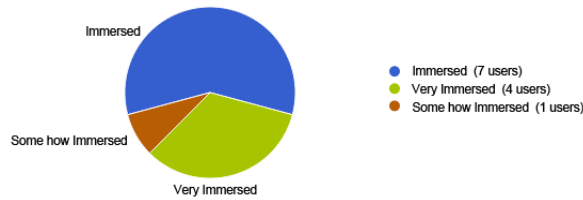
#### **3.1 Engagement**

##### **i Overall Experience engagement:**

Since the flow of an experience can be measured by a user awareness of time passing [53] we asked participants about their perception of the duration of the experience. We found out that 7 out of the 12 users thought the overall experience had the ideal duration, 4 users wished that the experience could be longer and only one user expressed that he wished it had been shorter. We interpreted these as general positive signs to have crafted an experience that encouraged flow and enjoyment. Furthermore, 2 users expressed the desire to have more stories and other places to explore. Lucas wrote in the questionnaire: *“I will be waiting for new stories here or in another street.”* Along the same lines Fernanda wished for an extension of the experience: *“Maybe we could receive an invitation to see more stories online or in another street.”*

Beside feelings of engagement, all users reported to have felt immersed in the street and the stories. In the questionnaire feelings of immersion were reported in different degrees. Users could grade the system through a 4 grade scale, with 4 levels of immersion: very immerse; immersed; some how immersed and not immersed. 4 out of the 12 users alleged that they were very immersed in the experience, another 7 users said that they were immersed, and 1 user of reported to be some how immersed. See Figure 43 for a visual breakdown of the data. It is interesting to note that the user who reported to be some how immersed was Manuela, who also replied in the questionnaire that the stories were too long. This can be an indicator that if the stories are not appealing to the users, generally the level of immersion is reduced.

How immersed would you say that you were during this experience



**Figure 43 – Graphic showing the users responses in relation to levels of immersion that they experienced**

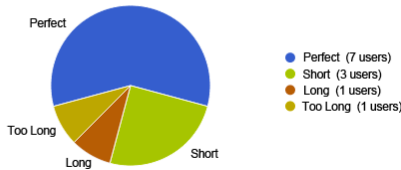
## ii Content engagement

A set of questions in the questionnaires probed users regarding the content they were experiencing. These questions regarded the duration of the content, empathy towards the characters and narrator; it also approached how overall engaging was this content for the users. For more details see appendix CD, Folder: Evaluation Chapter Documents\7 StoriesResponsessheet.xls the results for the questions (10,11,12,14,20,21). In the questionnaire, 11 users out of 12 of the users found the stories engaging. 2 users answered that they did not empathize with the characters. 1 of these 2 users, Luís, said that he empathized more with the narrator than with the actual characters that were in the stories. These results are encouraging regarding the quality of our content and the charm of our characters.

In the questionnaire we also asked how did the users feel in relation to the duration of the stories and we found out that 8 of the 12 users answered that the stories had the perfect duration. 2 users thought they were short and 2 users thought that the stories were long. See Figure 44. From these results, we feel confident about the chosen length for the story fragments, which were enjoyable, and about the right length for most users. We also conclude that the content engagement affects directly to how the users fell immersed in the experience. For example Manuela felt like the stories were too long and pointed out that she did not connected with any of the characters. She also said to have been only “some how” immersed in the experience, from this we can infer that this lower level of immersion is a reflection of user not feeling a connection to the characters of the stories therefore making the stories felt like they were too long. Resulting in a lower the level of immersion in the experience. On the same note Luis also reported the stories to be too long since he also did not connect with any of

the characters, but he did enjoy the narrator character and therefore we reported a higher level of immersion than Manuela.

In general would you say the duration of the stories was:



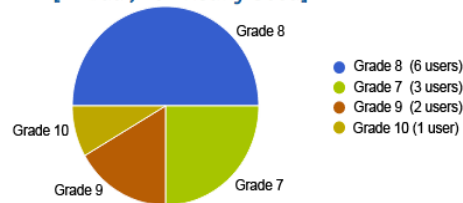
**Figure 44 - Pie chart showing the responses of the users in relation to the length of the stories**

When asked what the users will take away from the experience, most participants said that the stories are what they cherished the most. One of the users that was a visitor in Madeira told us: *“I learned about Madeira’s folktales and enjoyed it.”* One of the locals said: *“The stories! They were all new to me!”* While another local participant: *“it was cool to remember stories from my childhood [...] I remember my mother telling me some of the fortunes done in Santo Antonio festivities.”* As mentioned for the first study, the fact that participants report such engagement with the stories suggests that the system essentially worked as a successful cultural application, and our measures of improvement (adding markers and narrator) significantly smoothed the feeling of being overwhelmed and lost, and the audience could experience and enjoy the content more fully. This insight is strengthened by our observations: as participants were watching the stories, it was possible to see the enjoyment in their faces as illustrated in Figure 45 but also from the data of the questionnaires as we asked the users to grade the system as a whole. 6 users out of 12 graded the experience 8 in a scale from 1 to 10. Other 3 users graded 7, 2 users graded 9 and finally 1 user graded the system a 10. See Figure 46.



**Figure 45 - Users expressions of enjoyment**

From a scale from 1 to 10 how would you grade this experience?  
[1- Bad ; 10 - Really Good]



**Figure 46- Users responses when asked to grade the overall system**

As a further indication of engagement, we observed that the stories promoted conversation and exchange of stories. For example, the audience members that experienced the /stories in pairs discussed among themselves the popularity of Santo Antonio in different countries and cultures, while the other pair started discussing a folktale about witches from their own culture. Another participant told us that some of our folktales were similar to the ones from their own country and started describing them to the experimenter.

2 users in the questionnaire left suggestions regarding the content; Renata and Juliana would liked to have more stories about historical facts of the area and not just personal stories of people living in it. Renata wrote in the questionnaire: *“It will be interesting if it could have stories about some of the establishments that we see/visit on the route”* Juliana also said: *“I would tell more “real” history not just the folktales, but specific historical events that happened here, for example the history of fortress of São Tiago”*. Moreover, some remarks were made about the quality of the production. 4 users out of the 12 did make remarks about the quality of the sound recordings. 3 users noted that the audio of the narrator voice was of low quality,

which had some echo. Making us deduct that the production quality plays an important role in the overall story experience.

### **3.2 Orienting Function of the Narrator**

Our observations suggest that the narrator was effective in orienting participants. We noticed that the phone vibration works almost like a command: users immediately stop walking for a couple of seconds, they appear tense; then, as soon as the narrator starts talking, they relax and start walking again and look around. We also observed some participants nodding with their head as to signify “yes we can see what you are referring to” when the narrator points them to the location where the story happened. We can observe the curiosity lit up the users face and they seem very focused in searching for the marker. Pointers of the narrator to the surrounding architectural features, and to the connection between external landmarks and the filmed story can be crafted to a major satisfaction of the users.

Another indication of the effectiveness of the narrator was provided by Lucio answering a question about how to improve the experience, he said: “*some of the stories could make a better use of the surroundings (through the narrator) like it happens in the Santo Antonio statue, when the narrator says: look up! That’s the balcony from where the statue fell from.*” On one hand, this points out that the narrator works well, on the other that it could be used even more extensively than we actually did.

At the same time, we also gathered evidence of the limitations of the narrator as an orientation stratagem. First, we observed two users experiencing orientation problems at the beginning of the experience, where there is a street that splits in two. For example Nuno, who didn’t know where to go next, looked at the experimenter shadowing him looking for guidance. Then he looked to the map and scrolled the map in order to find a story icon and then continued into the correct side of the intersection. Also Justino when reaching the intersection asked the experimenter where to go next and as the experimenter did not intervene, he went left then right, then looked at his position on the map, then scrolled to see the next story position and eventually went in the right direction. Note that these two situations happened in the user tests where the sky was cloudy and the GPS wasn’t acting accurately, therefore

the narrator wasn't triggering at the proper times to give the pointers of where to go next. In fact, despite our efforts to make the user studies under clear sky it wasn't possible due to Madeira's almost unpredictable weather due to its microclimates[58]. Justino in fact, when asked in the questionnaire what would he re-designed about the experience he mention that it would have been helpful to him to have some kind of compass pointing out which direction to go after each story. Clearly, for this user the lack of performance of the GPS in triggering the narrator at the right time was instrumental in affecting negatively the experience and the orientation.

Another issue is that the narrator indications partially rely on the user being not too far from the story hotspot; otherwise it becomes harder to make sense of his guidance. For example Manuela after walking away from the marker, she approached the experimenter and asked: "*Where is this window that the narrator mention?*" The window in fact was just the one beside where the marker was placed but since the user kept walking forward she missed this connection.

### **3.3 Markers as tangible feedback and reward**

We observed that when participants find a marker, they smile or nod, as they experience joy or reward. Looking for and finding a marker becomes a treasure hunt experience. Many times we could observe the curiosity lit up the users face and they seem very attentive/focused as they search for the marker. Moreover, when we asked in questionnaire if they enjoying looking for the markers all the users responded affirmatively. And as we asked why they did enjoy looking for the markers 3 of the users related the markers to game elements. "*It looked like a treasure hunt with the videos (stories) as rewards*" – João; "*Because it created expectations, it was like a game*" – Nadia. The remaining users referred that they liked searching for the markers because they served as a link between the street and the stories, "*I felt like I was discovering parts of the street and since each marker was connected to the story, it made the search fun*" – Renata. Luís said, "*It helped me appreciate Rua Santa Maria better*". Moreover, all the users answered that they a sense of rewarding when they would find the markers because it meant that they could see the stories, "*I loved when I found one because I knew that I would hear another story*" – Fernanda.

Sometimes a marker was spotted before the narrator indicated it, in this case participants seemed even happier perhaps because they felt that they could find the marker without the narrator's help, somehow being cleverer than the system or the narrator, or beating it or him. For example Joao turned to the experimenter and pointing to the marker shouted with some excitement: *"I know there's one (story) here, right?"* Similarly, when Nuno found a marker before getting the hints from the narrator turned to the experimenter and said: *"I discovered the marker! Now I just need to wait for the narrator."*

As described above, the narrator, audio clips are triggered by GPS, so if a marker is found without the narrator's help, it is usually because the GPS is not working or it is slow in getting a fix. We noticed, then, that sometimes the marker could remedy these technical issues: participants would see the marker and wait for the GPS to update their position. Participants were actually very patient in relation to the time that the GPS would take to update, perhaps because of the trust inspired by the physical marker-object. They would sometimes take this waiting time as an opportunity to enjoy the street surroundings.

It was also interesting to observe in an experience in pairs, the two users would team up to look for the marker and share the enjoyment of finding it together (Figure 47), this happens in the case of the user study made with Natercia and Justino since the users share the same device.



**Figure 47 – Experiencing the 7Stories sharing the device versus each participant with their own device.**

In the case of an experience made in pairs where the each user has its own device, it's common to have GPS signals who are not in sync, consequently the narrator clue to find the marker is triggered at different times. In this way, the pleasurable discovery feeling of looking around in the street for the marker gets lost because one of the users goes straight ahead to the location where the previous user has already found the marker. This was observed in the experience of Fernanda and Davide. The narrator for Davide was triggered earlier than for Fernanda, and Davide went immediately searching for the marker to see the story. When Fernanda was ready to look for the marker Davide was already there, giving no opportunity for Fernanda to look around for the marker.

After capturing the marker some of the users start walking around, sometimes even deviating from the place where the story actually happened. Basically the users have relaxed from the quest task, and are preparing to receive the content they are no longer concerned with looking around. They are at ease and are just paying attention to the story. Some looked for places to sit and watch the story, others look to a place to lean over, or for a place with shade to fully enjoy and savor the audiovisual content, as we can see in Figure 48.



**Figure 48 – Users taking the liberty of finding comfortable places to watch the stories**

While shadowing our participants, we also observed that people, who were not participating in the user study, also noticed the markers in the street and often manifested curiosity towards them. Some people asked us, the experimenters, about what were that markers were for. Two teenage girls that were passing in front of the marker Witches 3 - Witch and the farmer in Figure 49 and one of them pointed to the

other: *“look at that drawing: it’s cute!”* Clearly the markers attract attention – we believe this characteristic of the markers can be exploited further. This interest shown by people that happened to be around while the users were performing the study was perceived by one user as he wrote in the questionnaire: *“ [...] there’s a novelty effect, people, especially locals, seem to not understand what is happening.”*

It was interesting to us to notice that when one of the markers fell down due to the wind, and an old lady that lives Rua Santa Maria kept it and returned to us later. Showing that the markers do look like something interesting and worth keeping rather than throwing it away or leaving it on the floor.

However, the marker recognition system also presents its limitations. At least 3 users experienced some difficulties in capturing the markers, and as a consequence 2 of them tried to exit the application and turn on the phone built-in camera application and capture the marker with it. In other cases, also with 3 users, our observation reminded us that physical landscapes, when present in concurrence with a marker, exert a strong attraction towards users, even more than marker. In the introduction of the Santo Antonio Fortune story, the narrator refers to a visible church located 20 meters from the GPS trigger position. When this happened, 3 users immediately directed themselves towards the church, ignoring the narrator saying that the marker was somewhere else. We observed that in the Santo Antonio Fortune story, 3 of the users after listening to the narrator introduction to the story started walking in the direction of a small church nearby. We noticed that the narrator in fact, in the intro for that story, mentions that there is a church on the right side of the street, but that the marker is placed a few meters ahead on the left side of the street. The users who went in direction to the church started looking for the marker over there. After a few minutes, checking with the GPS and noticing that their location on the map wasn’t close to where the icon that the story was positioned, they went back and eventually found the marker.

A specific questionnaire was done to probe deeper how people perceived the use of the markers in the experience, and if the semantics of the marker did make any difference in the experience. 8 questions were asked: what the users thought about the makers, how hard where they to find, if it was rewarding to find the marker, finally

we showed our users images of the markers and asked them to write something about the story that was related to that marker. For more details on the questions asked and the answers consult the appendix CD Folder: Evaluation [Chapter Documents\FollowUpQuestionnaire\Questions.pdf](#).

All the users enjoyed looking for the markers, found it a rewarding and easy task as they responded that the markers were easy to find. Moreover Luís, thought that they were too easy to find since he mention the questionnaire: “ I wish that they (*Markers*) *would have been more hidden*“ showing here a desire for a deeper exploration. This evidence points us in the direction of exploiting further the part of the experience that relates to the quest for the markers.

Regarding the semantic connection between the visual marker and the story content, some markers were more successful in making users recall the stories than others. The data collected in the small questionnaire that we made 3 weeks after the user study, showed that all the users remembered at least something correctly about one of the seven markers. For example, all the users associated and remembered the story about the old witch correctly with the corresponded marker (Figure 49,1<sup>st</sup> marker). 7 users remember the story about the boy who spilled the milk in the levada and associated it with the correct marker. (Figure 49, 2<sup>nd</sup> marker). The markers referring to the stories Sto Antonio 1: The Statue and Witches 2: Open Scissor were successfully connected to its corresponded story by 6 users. For the remaining three markers (Santo Antonio Fortunes – (Figure 49, 6<sup>th</sup> marker) and Witches3 – (Figure 49, 7th marker) Milkman the stolen cans – (Figure 49, 3<sup>rd</sup> marker) only 2 users remembered correctly the story for that marker.



Figure 49 - Markers used in the experience and evaluated in the questionnaire

It's evident that the markers have the potential to strengthen the experience but need careful attention in their design and choice of images representing the story. Further studies in this direction could evolve the visual markers graphic design. Nadia in fact made a suggestion - “ *I think the markers would be clearer if they had one/two keywords under the image [...].*” Nevertheless is rewarding for us to see that people could actually relate a marker to a specific story, something that wouldn't be possible with any other kind of marker.

#### i Marker-less content

In order to test the power of the markers, we introduced a story fragment, in the form of an “Easter egg” audio clip that was not associated to any marker. This exception was deliberately different from the rest of the experience, to serve as a sort of surprise for the users but also to try and see how participants reacted to content triggered just by GPS without a marker associated. As we expected, we observed that in this case participants looked intrigued, but also a bit confused as they were trying to understand which door or building exactly to look at. We asked to the users that showed confused expressions about this, they said that they were caught off guard and didn't know very well where to look at. For example, Nadia said, “ *When the narrator started speaking without expecting, it was exciting but then it was confusing too. I was looking around and at the same time trying to understand what he was saying*”.

This behavior could be explained by the fact that the structure of this clip was different from the rest of the experience. However, we believe it may also reinforce the importance of markers in this kind of location-based user experiences, and suggest that it could be interesting for further research to develop this sort of comparison.

### **3.4 Interface**

Part of the study was related to the users interaction with the mobile platform understanding the quality of the users interaction and to what level it was facilitating or impeding the narrative based experience we wanted the users to have.

Consequently, in the questionnaire, we included several questions related to the interface. Most of our users were familiar with the technology but were not familiar with the location aware system used for entertainment purposes since 9 out of 12 users answered that they never used a similar application. Nevertheless, all users marked in the questionnaire that the system was easy to use even Manuela who said that she was not comfortable with the use of technology.

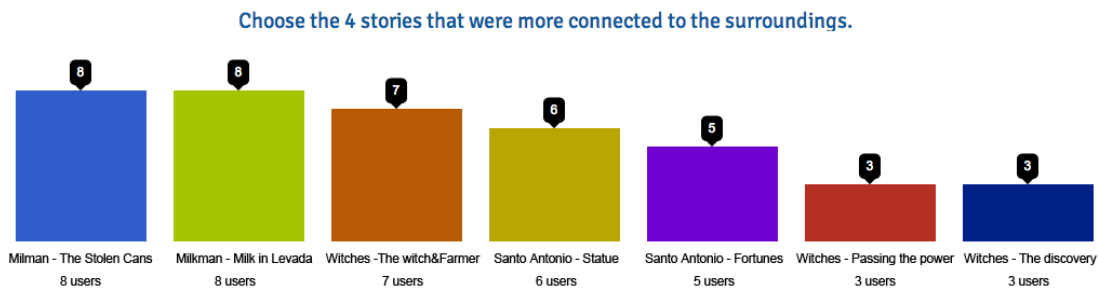
When asked about any problems that the users had encounter using the platform 4 users referred problems related to the GPS, either the GPS fix time or the GPS accuracy, no one mention problems with the actual interface, although we did observe that three users having difficulties to capture the marker at the beginning of the experience. Luís for example, was pointing the phone to the marker without pressing the story button to change into camera mode (though it had been explained in the preparation for the experience). In the post questionnaire, we asked him about this episode and he said that he forgot that he had to click the button, moreover, he suggested, *“to add something blinking in the button”* so that the user is reminded to click on the button. Nadia and Renata also experienced some difficulties in capturing the markers. Nadia exited the application and turn on the camera phone to capture the marker, Renata mimic the same steps. As Nadia saw that she wasn't triggering any story she went back to the application and pressed the story button and was able to capture the marker, immediately after that she explain to Renata how to capture the marker. We observed these 3 users having some difficulties handling the interface to capture the markers, but they didn't mention it in the questionnaire, making us infer that it didn't disrupt their experience in a memorable way.

### ***3.5 Relationship between the physical space and the content***

In relation to the connections between the stories, content and the location where they were delivered to the users, we collected different preferences and opinions. In the questionnaire we asked the users, which stories they found irrevocably and easily connected with the surrounding locations. The 3 stories that the users found to be more connected to Santa Maria street where the two stories about the local Milkman – Milk in the Levada; Milkman- The Stolen Cans and the story that related to the legend

of Santo Antonio statue that brings good luck to girls that are looking for a husband; See Figure 50 for more detailed data. Nadia in the post-questionnaire said: *“It was very cool to see in the Milkman story (referring to Milkman – Milk in the Levada) that it was shoot almost from the same angle as from where I was standing”*. Differently, in the story relating to Santo Antonio is the narrator’s comment that actually makes the connection between the story and the location work so well. Luis mention in the questionnaire *“some of the stories could make more a better use of the surroundings (through the narrator) like in the Santo Antonio statue, when the narrator says: look up! That’s the balcony from where the statue fell from.”* Interesting enough is that these 2 stories were the ones that the users voted to be the most connected to the psychical space. Pointing at easily identifiable real features in the surrounding helps in connecting story and physical location as well as improving the experience and providing a sense of magic and satisfaction.

When asked the best thing about the experience 7 of the users said that it was the combination of the stories with the location itself, and the other 4 users wrote that the best thing were stories themselves. One user wrote in the questionnaire: *“ the best part was to be where everything happened”* meaning that what he really enjoyed was to be right at the place where all the stories that he was watching happened.



**Figure 50 – Results of the stories that were perceived by the users to be more connected to the surroundings.**

## **4. Discussion**

All the work developed so far lead us to abstract some general implications on designing and implementing location based cultural applications. Since the overall experience was well perceived, no feelings of being overwhelmed and lost were reported in the re-designed 7Stories experience, we consolidated the results of both our studies through a number of considerations that we believe could be helpful for future researchers in the area of location based cultural applications in general and storytelling systems in particular. Such guidelines can be summarized in five main categories: 1) Design around technology failures; 2) Achieve a balance between the digital and physical; 3) Carefully design the markers role in the experience; 4) Design meaningful content; 5) Consider the social aspect of the experience. In the following section we will describe each guideline category in details.

### **4.1 Design around technology failures**

One of the main issues reported by users with the first version, iLand, is the inaccuracy and flakiness of the GPS consistent with literature about location based games and cultural applications [56, 26]. These often require a finer granularity or different settings (wide streets, little cloud coverage) where GPS would function at its best. This issue motivated us to design around technology failure (GPS), rather than fighting with the technology trying to insure a better GPS and more reliable functioning to our users. The adoption of a tangible, visual, feedback such as the d-touch markers had a very significant role in compensating for GPS failure. The markers give the users confidence that they are really where they are supposed to be. In fact the markers did not make the GPS work better, and GPS is still required to trigger the narrator's audio, but the participants seemed to be more tolerant to the GPS being slow, because they get the clear feedback that they are in the right place. Our findings were reinforced by the results obtained through the addition of a narrative clip that didn't have a corresponding physical marker to help the users. By observing our audience in reacting to the differently designed clip, we found support for our design argument. In fact experiencing this clip, without markers to ground it, the users looked lost, and reported feelings of confusion mixed with curiosity. Similar results

were obtained from the first study, where the system was functioning solely with GPS. We can then report the combination of GPS signal with markers as a successful combination in location based cultural application and suggest it as a solution when GPS cannot work at its optimal conditions.

Nevertheless an experience that relies even if partially on GPS, like 7Stories, needs certain weather conditions in order to function and to be enjoyable. Natural phenomena such as rain, too many clouds and too much sun will impede part of the fundamental traits of the application to manifest and behave properly. Namely the GPS will perform too erratically if it's a cloudy day, rain could also ruin the device, and strong sunlight will affect the screen visibility.

#### ***4.2 Achieve a balance between digital and physical***

Regarding the connection between the locations and the stories, three main implications for future design can be highlighted.

First, attention should be paid to balancing and smoothly orchestrating the transition that the audience must make between real and virtual space. In our first study users at times devoted too much attention to the screen and had difficulties to find the relevant architectural landmarks that they had been invited to find in order to anchor the stories in the real space they were exploring. On the other hand other users were observed being lost in the real space, and had to ask the supporting person where to go next to retrieve more content. Some users focused on real landmarks ignoring the system suggestions of where to find content. Both issues denote that a fine balance between the two realities, need to be achieved. Nevertheless, in the second system, the balance was much closer to an enjoyable flow of experience, as no user lamented having to focus on the screen too much, but on the contrary the markers smoothly highlighted details of the physical space, before the audiovisual clip absorbed them. This experience reported through the second study lead us to propose vibration and markers as successful strategies to balance virtual with physical space in a location based experience and highlight the importance of transitioning users smoothly from one plane to the other. The vibration alerts the users of audio content, while they can still focus on looking around the real space. The marker allows users to focus on the

physical details of the space take it, and then when ready the users capture it. Consequently they enjoy the audiovisual content, without feeling to have to split attention between the two dimensions.

Second, it is important to incorporate visible and clear landmarks while storyboarding and producing the content. Very prominent landmark such as churches, old buildings, with particular look have a power by themselves to attract passersby, including users of 7Stories, as we observed in the study. Users felt drawn to landmarks such as churches, statues, or colorful buildings and started looking for the markers nearby even if the narrator or the mobile interface indicated otherwise. After a few minutes, not finding what they expected, they checked the GPS and noticed that their location on the map wasn't close to where the icon of the marker was positioned, so they went back on the road that they had left. Such findings highlight an important issue when designing for site-specific experiences: although the real space around the users may not be part of the designed trajectory of the experiences, it strongly influences the trajectory of the users. Despite the mobile interface, markers and narrator guidance, users would still take the physical world as a main reference. They would consider landmarks in the real space as reference and strong clues for where their experience should happen and interpret it at their own accord, over which we have little or no control. Therefore, when choosing where to place story content or references to story content such as markers, designers need to be aware of visible landmarks that already exist in that location and possibly make use of them to attract or direct users where they would like them to go.

Thirdly, the visual link between filmed material and physical locations can help generate what has been identified by Reid et al [54] as a “magic moment”, a moment where the users experiences excitement or joy in overlapping the world they are living in with the world of the story being told. The ideal way to achieve this would be to film the content, whenever it's possible, in the location where the story will be delivered or carefully make relevant in the story some aspects of the landscape.

### ***4.3 Carefully design the markers role in the experience***

Concerning the role and the potential of the markers, its aesthetic role and its placement there are important issues to keep in mind emerged from the studies.

The aesthetic function of the markers was well received as some users found them cute and triggering curiosity. One lady who lives in the street, kept one of the markers when it fell off the wall, she saw it as something to be valued. Moreover, the markers can work as a catalyst of the experience. People see them and this may encourage them to try the experience or to contribute with stories for the content. Furthermore, to be found and captured, the markers require an action that the users perceive as a pleasurable, exciting, and rewarding. In the light of these findings, it can be said that markers have been used instrumentally as well as provided the contextual link that aesthetic interactions should provide. Accordingly, they promoted involvement in the experience, surprise and serendipity in interaction, when finally found where expected and where known.

The markers locations need to be chosen very carefully, some situations that are unpredictable may occur, like for example a car may park in front of the marker or a street fair can hide the place where the marker is. As a consequence, people may not see the marker or may not get close enough to capture the marker and see the story.

Extra care needs to be paid in terms of the material of the marker and the level of reflection that it may produce when exposed to the sunlight. Depending on where the marker is placed the reflection of the sun in the marker can change, at different times of the day, so in the morning the marker can be captured perfectly but in the afternoon the sun can be shining into the marker. This will produce a reflection and therefore being harder to capture the marker with the camera phone. Furthermore the use and balance of local physical landmarks should be considered, as exposed above in topic 4.2.

#### ***4.4 Design meaningful content***

As we mention several times before the content is one of the most relevant aspects of an overall story based experience. Stories are what prompts the feelings of immersion and wanting to keep on going until the end or closure. Here we will describe the two different types of content that we have produced in our experience, the narrator and the stories, and how they were beneficial to our experience.

With the addition of the narrator to the 7Stories, there were no reports of feeling overwhelmed in the audience comments, and very seldom people needed to ask for direction or our help compared to the first version of the system. This indicates in general that the approach of using a narrator to support the users in the exploration of the narrative space and physical environment worked well and overall helped in delivering a more satisfying location based experience to our audience. Furthermore, the narrator character can influence the perception of the stories as real or fictional. Our character truly existed, and was portrayed as a real one, this made people keen to believe that all the stories narrated were true. The trail that the narrator led the users to walk might contain landmarks that should be referred to by the narrator; this will strengthen the connection of the virtual with the real space. The length of the path users walk between markers should be timed, so the narrator can be triggered and listened to without overpassing the markers too soon. Moreover, after capturing a marker some users start walking around the street, even deviating from the place where the story actually happened. The freedom that was gained after having captured the marker, hence being sure to be in the right place, needs to be taken into account since it affects the surrounding in which the audience will be when the narrator wraps up each story fragment at the end of it. In conclusion, the narrator is a successful asset for guiding the audience through a location based experience; its function has to be exploited, in terms of connecting the story content with the real space, and correct timing of its interventions and the timing of the audience walking through the physical space.

In relation to the stories several factors need to be taken into account when designing content for an audience on the move, for example the duration of the story. It is very hard to tell a story in less than two minutes and make the users care. On the other

hand more than three minutes is too long to keep the users attention especially outdoors where several distracting factors are around. In the end, if the characters, or the plot of the story fails to captivate the user interest, the story will be perceived as too long or boring. Engagement with the stories is a fundamental element in the experience. In our evaluation the fact that only 2 users out of 12 were dissatisfied by the stories was an important alarm bell, which point us towards flaws and possible improvements of the story experience. Improvements such as: a good and very tight editing of the content with no redundancies help users feel immersed and captured by the story, we should keep in mind that people might want to listen to some stories and not others, and its important they can exit and terminate the specific audiovisuals of a story without loosing the overall experience feeling. Finally we learned that we cannot please everybody, but we should make sure that we target our audiences carefully, so we can produce content strictly tailored for them.

Moreover, story genre plays a role. In our experience users responded well to the stories we told but when an experience of this sort grows and more content is generated, the stories could be divided by themes to accommodate different kinds of audiences, in this way they could choose to watch stories according to theme that they prefer.

The quality of the media is fundamental in the delivery of a highly pleasurable experience. If the content quality is perceived to be low by users it can definitely influence the overall experience, affecting its credibility and aesthetic pleasure.

#### ***4.5 Consider the social aspect of the experience***

From our studies, it appeared that not only the recruited users but also people that were in the surrounding got curious and sometime involved with the experience itself. This is an encouraging result, as the comments and reaction from people external to the study, or passer by have been always of a positive nature. Despite our feeling of success about having engaged passersby and triggered external people curiosity, some of our users were bothered by the fact that people would look at them while they were going around capturing markers and looking at the videos on the mobile device. This is and important factor to keep in mind: the potential annoyance or awkwardness

some users might feel in being the center of attention and source of curiosity for the passers by in the street. This uneasy and embarrassment feeling of the users has to be taken into consideration in the design of location based entertainment systems that engages audiences in public spaces. It can disturb the experience, render users shy and eventually disrupt, interrupt or ruin the experience for them altogether.

Some of our users tried 7Stories in pairs and all of them enjoyed the sharing factor. Nevertheless some downsides were noted. It was hard to share the small screen. On the other hand having two devices instead of one could cause incoordination in spotting and capturing the marker. In fact, we noticed even that a user running up ahead another one, and discovering the marker first spoils part of the treasure hunt for the other one. For users who decide to take experience 7Stories together from the same device, perhaps we should consider a bigger device like a GPS equipped tablet with two sets of headphones, because the GPS position can be different for two devices and might cause asynchronous experiences.

## Chapter VII. Conclusions and Future Work

Throughout out this thesis we have presented the design, implementation and evaluation of 7Stories, a distributed location based narrative experience set on Madeira Island. We intended this experience mainly for tourists, who are always seeking for experiences that are authentic and somehow explorative where there's a balance between some novelty, adventure and safe exploration of a new place. We conceived 7Stories in order for tourists to learn something not so much about the old part of the city of Funchal, its monuments and historical facts, but specially to get to know its inhabitants, the common people that live and lived there. 7Stories emphasizes the history and cultural background of the Funchal downtown community, and helps tourist to understand the lifestyle of the locals.

Today the basis for location aware multimedia narrative is well set and underway nevertheless the potential for further research and development in this area is still wide and challenging, as noted in the projects that we studied in the related work section. In order to progress and contribute to the designed development of location aware stories, we enhanced the use of GPS technology for location aware narratives, with visual markers. To contribute meaningfully to the field, we started by evaluating an existing LAMS platform, PlaceWear, with new content relevant to the Madeira culture and in specific to downtown Funchal, the old part of the city, where tourist always walk around. We called the delivered experience: iLand experience. The iLand content is made of 7 stories about to the local folklore. The content was scripted, shot and produced as 2 to 4 minutes length multimedia audio and video clips. The iLand small-scale evaluation let us set the base of the current system and identified a set of problems and issues that emerged from the collected data. From these findings we were prompted to redesign the system. More specifically, to tackle the lack of context of the stories presented and lack of feedback after the users watch the stories, a narrator was introduced in the experience, he presents each story and makes the user understand why is he seeing that specific story in that specific place. After each story the narrator will intervene not only to give an insight about the story that the user saw, but also to leave an instruction for the next story. Moreover the fact that the GPS accuracy was poor and was affecting the core of the experience by

making users feel disoriented, we addressed this problem by using the d-touch markers in specific location and asking the users to find them before delivering the site-specific content to them.

Once the system and content were redesigned a new experience was born: 7Stories. A second qualitative evaluation took place in the same setting of Rua Santa Maria. In this setting we were able to observe how these specific features worked, or did not work, as improvements for the user experience. The results showed that beside feelings of engagement, users reported to have felt deeply interested (immersed) in the street and the stories. These results are encouraging. The fact that participants reported such engagement with the stories suggests that the system essentially worked as an engaging and pleasurable cultural application for tourists to experience in the old town of Funchal. Moreover our improvement and redesign of the story design, interaction and the interface (adding markers and narrator) significantly smoothed the feeling of being overwhelmed and lost, and the audience could experience and enjoy the content more fully.

We finalize our work by building on the analysis of our results and indicating general guidelines and implications for the future of the design of location-based narrative systems. In particular we call attention to the importance of carefully maintaining the balance between digital and physical aspects of the experience, and to how technological as well as content solutions can help with that. We envisage our findings helping other designers in designing and developing location-based applications and cultural storytelling experiences, and, more in general, encourage the comparative deployment of multiple versions of the this kind of systems.

In terms of future work, regarding the experience delivery platform development efforts should be made so that it works across all versions of Android and iOS. The experience would benefit by being developed for a tablet equipped with GPS; tablets with a bigger screen would enhance the experience of watching the stories.

Moreover the narrator is a rich avenue to explore in future project to guide users in the experience. We also would like to reinforce the importance of the markers in this kind of location-based user experiences, since it can tackle the problem of the inaccuracy of the GPS but also it can add another layer of meaning to the story

experience, since the d-touch markers are semantically meaningful for humans and could be part of the unfolding of the story, play a role as cues to find out important details or simply provide aesthetic pleasure in finding them.

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## **Appendix**

Please refer to the CD attached to this thesis.