



# A Storytelling Smart-City Approach to Further Cross-Regional Tourism

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**Abstract.** Museums are crucial elements of regional and local cultural offerings and can play a major role in tourism-related, educational, economical and urban-planning policies. To increase visitor numbers and thus further cultural exchange between regions and economical profit, we provide insight to a storytelling-based smart-city approach that routes users between the age of 14–25 years across 8 museums along the Dutch-German border using both Informations and communications technology (ICT) and gamification as part of the Rhhijland.Xperiences project. Creating an appealing user-experience is a key-objective as the users motivation to continue his journey between the museums will highly depend on it. Each visit at one location facilitates the longing for visiting the next museum in the network. This approach is applicable to various other sets of institutions or points-of-interest (POI). The project itself is yet in a development stage and its product will be released by 2020.

**Keywords:** Museum digitalization · Smart-cities  
Intercultural exchange · Mobile technology · Museum devices  
Story-telling

## 1 Introduction

Engaging citizens and fostering educational and cultural offerings among cities using ICT can be described as a Smart-City's key-objectives. In 2010, 41 % of all estimated 9.92 million foreign tourists that traveled to the Netherlands have visited at least one museum [2]. With a total of 14 Million visitors expected in 2020, museums play a key role in city's tourism and thus economical policies up to marketing and urban planning strategies [2]. Since the increase and preservation of visitor numbers has beneficial effects on a cities' cultural awareness and economy [2], the attraction of visitors is desirable. As part of the Rhhijland.Xperiences (RLX) project [4,6], we provide a smart-city approach that aspires to boost visitor numbers by routing visitors between a set of 8 museums

across the Dutch-German borders using ICT paired with challenges in forms of riddles and mini-games. This approach can be applied to other public sectors as well. Applying digital technology to enhance museum visits itself is not a novel approach. Especially in the current decade, with the rise of high-performance mobile-computing public institutions such as museums already provide digital experiences to successfully engage a wider audience [3]. However, utilizing digital technologies to draw users across interregional POIs using ICT raises specific issues as themes and experiences of POIs may vary as well as the expectations and skills of a broad audience. To escalate the motivation to visit multiple locations, story-telling methodologies are being established and applied to maintain an engaging experience. However, the thematic diversity and the user-determined sequence of museum visits requires the creation of a flexible narrative structure. A focus on the target audience, which primarily aims at youngsters between the age of 14 to 25 years, requires additional consideration, as well. Therefore, user research must be conducted and both the story and the game-play of the individual games have to meet the interests of those that match the target audience. Since smart-phones are a wide-spread ICT among youngsters in western cultures [7] it appears coherent to deploy the story and games on smart-phone devices in form of a mobile-application. Aside an engaging story, the experience is also defined by the games and visual design that is used to keep the user motivated [10]. For each museum, the system can include interaction with stationary devices to supply the user with a more diverse amount of challenges or screen-based and AR-based games. This paper focuses primarily on tackling the challenges mentioned above and describing the designated smart-phone implementation, whose games can range from puzzle games, up to Beat-Em-Up mechanics and beacon-controlled events as stationary devices are still in conception. The project is mainly financed by the European Union's Interreg program and the project's partners. Together with Erfgoed Gelderland, Rhine-Waal University of Applied Sciences in Germany, HAN University of Applied Sciences in Holland and the 8 participating museums:

- Museum Arnhem (Arnhem, Netherlands)
- Openlucht Museum (Arnhem, Netherlands)
- National Bevrijdings Museum (Groesbeek, Netherlands)
- Geldersch Lanschap Kasteelen (Ammerzoden, Netherlands)
- Museum Schloss Moyland (Bedburg-Hau, Germany)
- Museum Kurhaus Kleve (Kleve, Germany)
- Museum Goch (Goch, Germany)
- Archeologischer Park Xanten (Xanten, Germany).

Due to the large amount of stakeholders, clear and constant communication remains a mandatory feature during the conception and the development, as well as during marketing. Therefore, constant meetings are held to ensure the state of knowledge regarding the projects state, goals and concepts.

## 2 Related Work

Over the current decade ICT has become more prominent in the cultural sector. Ranging from applications that route users between regional points of interest up to VR-museum tours for home usage, mobile- and CG-technology has been successfully used to peak people's interest in visiting cultural institutions.

In 2013, the National museum of Scotland launched its *Capture the museum* application. Within that application visitors can join one of two teams who's goal is to claim virtual territory by solving puzzles and other virtual challenges within the museum space using AR-technologies.

In the scope of the RLX project Jacobs et al. have previously outlined vital aspects of the designated application to provide enhanced museum experiences, such as mixed-reality blended experiences [4], co-creation with the stakeholders, story-lines to connect museums, museum infrastructure and visitors devices. Moreover, Jacobs et al. present its novel 1-10-100 method for concept creation involving multiple stakeholders [4]. Additionally, Kahl et al. have already described the Rhijnland.Xperiences project at an earlier stage, outlining user- and business requirements, as well as requirements to the storyline [6].

The CHESS project, conducted extensive research in the application of mobile technologies and storytelling in the museum sector. One of the main focus points of the project was the attempt to prioritize the focus from "exhibit-centric, information-loaded descriptions, to story-centric narrations with references to the exhibits" [6]. One of the difficulties to overcome during the project was to create appealing mobile applications through the use of exploratory activities, an adaptive game-experience and AR-representations of cultural artifacts wrapped in a drama-based storytelling approach. As the visitor enters one of the enhanced museums, an introduction to the story is revealed and exhibit- and theme based episodes are presented to direct the user towards exhibits using narration and on-screen instructions on the users' devices. After all exhibits have been visited, the experiences closes with an end to the story. Based on an earlier paper [6] which is describing this project in an earlier stage, we present a more accurate outline of the content or storytelling-aspects that are being applied within the project.

## 3 Requirements

### 3.1 General Requirements

One of the project's main factors to consider is the target audience. Therefore, user-centered design methodologies such as design thinking, prototypes, user-surveys and focus groups have been applied. Based on existing research we already determined that to enhance the museum experience for youngsters our application should include non-monotonous experiences, games and location based technologies. In addition during prototyping, we found that participants enjoy the possibility to scan for objects as part of a trial, while some did not approve of traversing the museum by literally jumping back and forth between

different floors. Therefore we found that the user's route has to be linear, in a manner that no exhibition has to be visited twice. In focus-group sessions with the stakeholders, we found that although the designated audience consists of 14–25 year-olds, we should not lose sight of older and more-experienced visitors, as well. While the implementation of a cartoon-like and futuristic-looking core-design and mini-games clearly addresses younger visitors, the incorporation of a stimulating storyline might aid in creating an appealing experience for visitors above the target age as well. Finding the right balance in the difficulty and complexity inside the mini-games is a major challenge. While younger visitors might easily understand complex game-mechanics from games that they played on video-consoles, older visitors would find these mechanics possibly not as intuitive [11]. The audience should have the possibility to start from every museum, which requires a modular storyline approach that is yet linear. Ideas of an interactive storyline have been suspended due to the complexity of 8 museums that are diversely themed and the tight project life-span. Within our user requirements we found that stories dialogs should be context-sensitive and incorporate the route of the user inside the museum.

### 3.2 Technical Requirements

The wide spread of smart-phones especially amongst youngsters along with the increasing performance, high mobility and ICT capabilities convinces us to choose a mobile-application as our main-platform. The application is complemented by a set of stationary installations such as interactive kiosks. Each of the 8 locations raised different technical challenges: For example, the Museum Schloss Moyland does not provide any internet-access while Archeologischer Park Xanten does not qualify for the use of beacons [12]. Another technical but not yet as obvious limitation is the spatial size of the exhibition and the battery capacity of mobile devices. Especially the computational efforts of AR-Based games can rapidly deplete energy resources. Without any additional power-supply, the duration of these particular experiences may not be overextended. The time of game-play has been limited to maximum of 1 hour, in order to conserve the power of the player's cellphone.

Also, the size of the application on the device must be taken into account as many youngsters can not afford consuming large bandwidths and most museums do not offer free internet-access. We consider implementing a modular location-based data-structure in combination with pre-download features for that matter. These limitations must be kept in consideration to meet the requirement of accessibility at every location. Another technical key-aspect is interchangeable content that goes hand in hand with a modular structure: In case one exhibit has to be replaced with another one modularity and specialized authoring software is required for the museum administration to adapt the experience. As a fall-back, it is possible to restrict the application to permanent exhibition pieces.

Performance of smart-phones is a key-factor that is crucial to the application accessibility. High resolution 3D-Models combined with expensive game-mechanics and AR-features can overburden the device's capabilities which results

in a poor user-experience. For the release date in January 2020 we consider smartphones such as the currently wide-spread Samsung Galaxy S7 as *prev-gen* and will gear up to its specifications to provide a balance between graphically appealing and yet slightly backwards-compatible graphics without oversizing the application.

## 4 Story-Framework

### 4.1 Storymodules

As stated earlier, the story is kept in a modular fashion allowing a linear storyline which adapts according to the order in which the user visits a museum. The main events stay the same at the end of each chapter, while the location differs. Our framework can be subdivided into three module-types. The overall linear story of the game is divided into story fragments that we name Universal-Story-Modules (USM). All USMs are however, fairly unrelated to the currently visited museum. To connect the story with the locations we utilize Local-Story-Modules (LSM) that tell a location-specific story that triggers progression of the USMs upon completion. Each LSM consists of Mission-Modules (MM) which are puzzles and games that are tied to exhibits and other POIs inside a museum.

### 4.2 Narrative Design and Challenges

As stated earlier, creating an appealing and applicable storyline raises several narrative challenges:

- **Thematic diversity of museums:**

The museum network that includes 8 local museums bears a vast variety of themes, ranging from local art up to historic events of different time-frames. Therefore the story must at least address all of those diverse themes. Our approach of using distinct local story-modules for each module that connect to an overall story-line is one way to tackle this challenge. A selection of entities that are displayed in the museum, either as part of an exhibition or location must be made to create a pool of portals. Each of the portals shall reference the current museums theme and also a theme of its target museum.

- **Multiple entry points:**

The fact the sequence of museum visits shall be user-defined and therefore allow the user to tackle each museum without any restrictions in order requires a flexible story-pattern. We propose a linear narrative design to reduce complexity in reduction in which details differ according to the order of museum visits. Whereas the dramatic events remain the same the location of the plot changes. As a result, despite a linear storyline each player will achieve a different version of the same story.

- **Irregular progress of the story:**

Since the challenges to progress in the story are bound to the museum locations, it is conceivable that, depending on the visitors motivation, the continuation of the story will not succeed in regular intervals. This may cause the user

to forget about story-content which might widely affect the user-experience. Therefore, we aim to implement journals in which the player can revise content from past visits. Moreover, the possibility to reset a local story-module's progress also enables the player to repeat the latest events.

For a narrative design we aim to establish a universal structure that can be applied to every museum. A structured and intuitive design structure is vital to the applications user-experience.

In the first step that is processed after the user opens the mobile application inside the museum, a simple check is performed whether the user has already started a local mission in that particular place. If not, the application will check for the current USM and will provide the user with a USM-cut-scene to understand the current context of his museum visit to the global story. Right after the first cut-scene the user is introduced to the current LSM by an additional cut-scene. Subsequently, the user is introduced to an explicit mission module which starts with a short dialogue that is explaining the possible interactions and whereabouts of his next target location which he has to approach. Once the visitor has reached the vicinity of a location, a query is performed whether the location matches the target location of a current mission module. If the correct location has been reached, the mini-game or challenge starts. Upon completion of the challenge the user is introduced to the next mission module (4). If the user has already started a mission module in the current context, he is asked to choose between resetting or continuing his progress. Once the user has completed all the challenges a final cut-scene of the local story module appears and the user is presented with a hyper-portal which directs him to the next museum where the story would continue (Fig. 1).



Fig. 1. An overview of our story-module structure

### 4.3 Main Plot

In order to utilize the described framework, we established a plot that can be outlined as follows:

The player is invited to become the apprentice of a mysterious woman called the trader. The trader is immortal and has the ability to access a hidden layer of reality in museums which is an amalgam of emotion, ideas, and memories left by humans on artistic or historical artifacts and locations. The trader provides an app to the player to interact with this reality and asks her to do missions for her. The earlier missions are legal trade work and require interactions with museum mascots, i.e. helping them, trading with them etc. Later missions seem to be somewhat illegal. The museum mascots warn the player that the trader might have a dangerous hidden agenda. The player is given the mission to track the trader. The player finds out that the trader has been collecting powerful personal memories which may give her the power to destroy the hidden reality. When the trader learns that the player has been spying on her she fires her. The museum mascots start to give the player missions to stop the trader. When competing to collect the final memory it's revealed that the trader actually wanted to end her immortality in a human manner. The museum mascots on the other hand filled with negative emotion from the anger about the trader's plannings now want to obtain all the memories to gain power. The player and the trader face the mascots filled with negative emotions. The trader uses her memories to cleanse the mascots from negativity but in doing so sacrifices herself and dies. As she dies the app slowly loses the ability to access the hidden reality and the player gives his/her farewells to the now healed mascots for the last time.

#### 4.4 Hyperportals

Within the scope of our project, Hyperportals are a key-feature to encourage the user to visit another museum in the network. Hyperportals provide a short but meaningful insight to another museum's location and local story-module to promote the user's awareness and interest of other location in the network and thus encouraging further visits. These insights can be provided through real-time video streaming, computer-generated animations and AR-based windows or stationary-devices with video-output. To integrate Hyperportals into the story and the locations in a meaningful manner references both to the story and the locations are imperative. Thus choosing the right object/space to view through the portal is one of the main challenges to further the cause of the user being routed between the museums. For the visual design we aim to create dark-themed portals that provide a sense of mystery that shall spark the user's interest.

#### 4.5 Culture-Caching

Analogically to Geo-caching [13], Culture-caching requires the user to visit various locations and collect virtual objects of cultural significance. With the rise of GPS-capable mobile-technology, app-based geo-caching games have gained prominence. One of the most prominent examples from the current decade is Pokemon-GO in which players can collect virtual creatures and trophies by traveling to points of interest in the real-world. Likewise, editable Geo-Caching applications that enable the implementation of custom stories and trips for hiking

events are a wide-spread phenomenon that delight numerous players [13]. For the purpose of our app we adapt the concept of Geo-caching and alter the objects to collect and find to something thematically fitting (e.g. cultural-meaningful). Therefore, instead of being routed between random POIs and collecting virtual monsters and such, the player is supposed to collect virtual historical artifacts from museums that provide a meaning to the cultural and historical background of the location.

## 5 Game-Mechanics

Throughout the game the player is faced with several challenges in form of mini-games. Those can be enumerated as:

- **Scan for the object (revealing or identifying mechanics):**  
The player has to locate a certain object (e.g. a picture) within a museum space. This is usually aided by a vague description about the object’s background. Once the player has located the right object, AR-technology is used to scan the object to finish the challenge. Upon detection “hidden”, object-related 3D-content would be revealed to improve the experience. The player then may have the opportunity to interact with the revealed content. During field-testing of prototypes, we have received positive responses by the audience (3 students, age 20–27) and between the age of concerning the enjoyment of these mechanics.
- **Collect or catch the object:**  
One possible interaction would be the collection or catching of an item. For instance, the scan of the right object would reveal a treasure box that emits coins that the player would have to catch in a certain amount of time. Similar mechanics have already been successfully applied in ‘Moorhuhn’. A German shooting-game, that captivated millions of players from various generations.
- **Carry and drop the object (object movement mechanics):**  
Another possible interaction mechanic would be the physical moving of an virtual object by oneself. The challenge would be the task to balance the object onto a virtual plate that is hooked into the smart-phones gyroscope. Once the object slides off the plate, the challenge is lost, if the object reaches the destination point, the next challenge, in which the object has to be placed would arise. For instance, the player would have to use swipe-gestures to throw the coins into another container, similar to the popular mechanics of PokemonGO [15].
- **AR-Beat ’em up:**  
Beat ’em ups have been a popular and yet simplistic genre since the 1980s for young and old [8]. Thus, famous games like *Streetfighter*, *Tekken*: or *Dead or Alive* still count as the most famous console franchise. We adopt and combine these mechanics with AR-technology allowing the player to experience a Streetfighter-like experience on any arbitrary real-world surface. Beat ’em Ups, can be described as fighting-games, in which a player controls an avatar that has to defeat his opponents with martial-arts.



- **Pac-Man:**

As a screen-based solution, we decide to create Pac-Man abbreviations that fit into a museum's theme due to its simplicity and popularity. The player has to escape from his/her foes on a two-dimensional grid while reaching a target area to win [9].

- **Color-the-Frame:**

An AR-based game, which is an abbreviation of the revealing or identifying mechanics. The player has to find an object via AR such as described above and paint is going to shoot out while a museum-themed frame appears around the player's screen. Each half is painted in two different colors. Catching the color causes the second color to change through mixing the existing color with the caught one. Once the player managed to match the first color the player has won.

- **Draw-the-silhouette:**

The player needs to draw a silhouette of an object on the mobile-screen with its finger. If done correctly, the player wins. We assume that this game mechanic is easy to understand and its mechanic can be reused in every museum. Prototypes have proven to be fun during testing.

- **Classic riddles:**

Riddles with location-themed multiple-choice questions will also be a part of our framework. We are not clear yet to provide multiple-choice riddles or allow the user to type in results on its own which impacts the riddle's difficulty.

## 6 Conclusion and Discussion

This paper provides a first glimpse on a smart-city approach that may have the potential to create a cross-boarder museum experience and thus enhancing a city's economical and educational state. The usage of mini-games and storytelling (in this case museums) should foster the motivation of youngsters to traverse places. Games such as *PokemonGO*, have already proven the high potential in that matter. We do not yet have a clear concept on the interface design, as to the project's early development stage. However, iterative, user-centered design methodologies are being applied to elaborate on an appealing and intuitive product. The large diversity in technical restrictions between each POI, requires extensive planning and testing and may cause some game-mechanics to be left unimplemented at a particular region. The fact that some of the POIs do not provide any form of internet-connection will require the conceptions of workarounds. All-in-all, we believe that the foundation on terms of early prototypes and an established framework will provide us with a solid base to build an appealing and successful product.

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